

Marine Engineering

Volume XXV

DECEMBER, 1920

Number 12

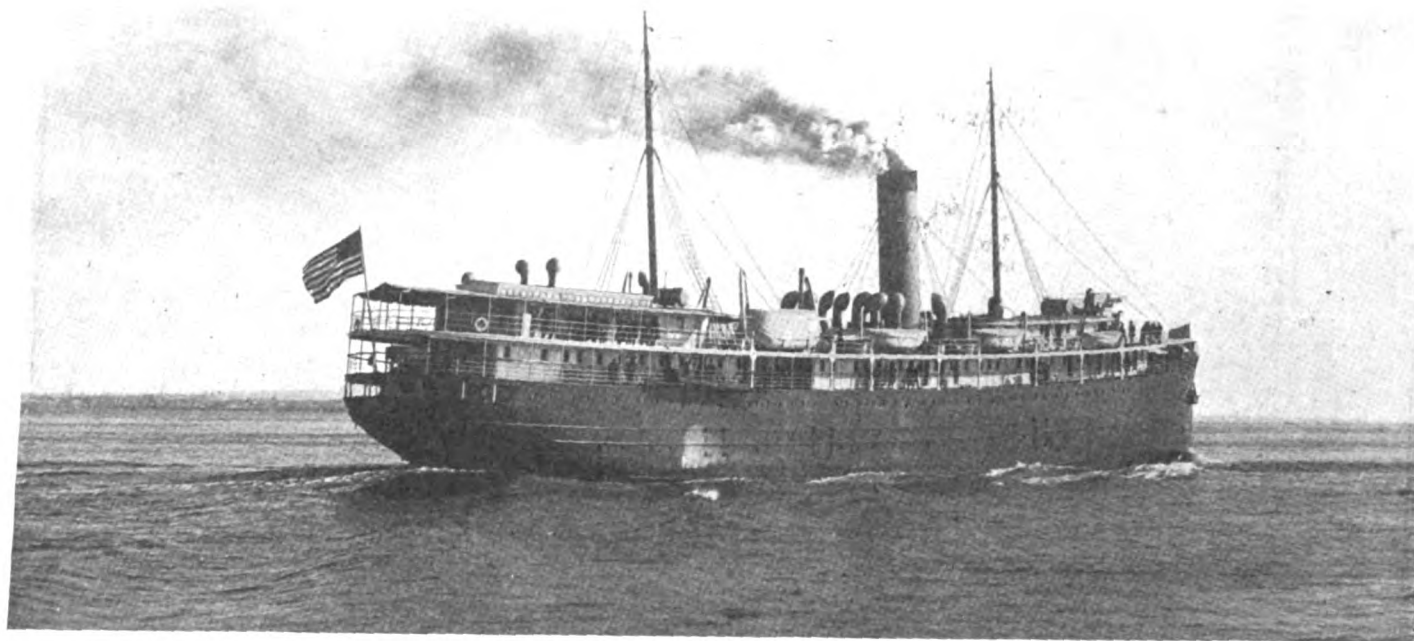


Fig. 1.—S.S. Cuba, at Full Speed, Showing Flat Wake and Small Wave Formation

(Photograph copyright 1920 by Edwin Levick, N. Y.)

Electrically Propelled Passenger Ship Cuba

**First Passenger Ship in the World to Be Equipped
with Electric Drive—Vessel Has Speed of $17\frac{1}{4}$ Knots**

BY JAMES A. KELLEY*

THE steamship *Cuba*, now running between Jacksonville, Fla., and Havana, Cuba, and operated by the Miami Steamship Company, is the latest product of the Morse Dry Dock & Repair Company, Brooklyn, New York.

To the *Cuba* belongs the distinction of being the first passenger ship in the world to be driven electrically, and to the Morse Dry Dock & Repair Company the distinction of installing the machinery, which was furnished by the General Electric Company, of Schenectady, New York.

CHARACTERISTICS

The principal dimensions of the *Cuba* are as follows:

Length between perpendiculars.....	290 feet 6 inches
Length overall	328 feet
Beam, molded	40 feet
Depth, molded	26 feet 9 inches
Draft forward	16 feet
Draft aft	18 feet
Mean draft	17 feet

From Figs. 2 and 3 it will be noted that the vessel has a fine underwater body. The block coefficient on the 17-foot waterline is 0.61, giving a displacement of 3,580 tons in salt water.

A sea speed of 17.28 knots was obtained on recent trials

* Naval architect, Morse Dry Dock & Repair Company, Brooklyn, N. Y.

with the machinery installation delivering its full power of 3,000 horsepower.

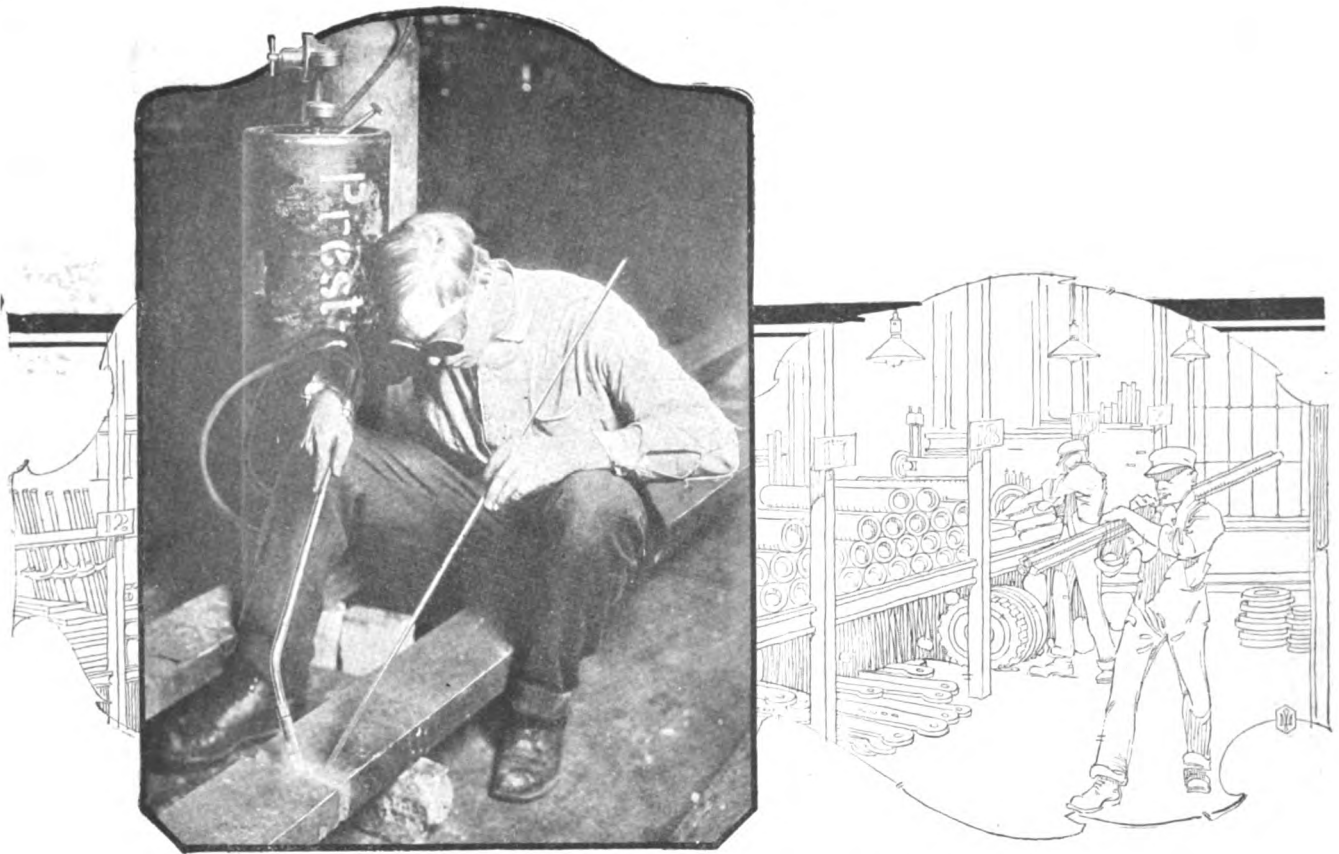
ACCOMMODATIONS

In the design of the vessel and its accommodations considerable attention has been given to the run in which the vessel will be placed. Everything for the comfort and pleasure of the passengers has been accomplished and the vessel could well be called a luxurious yacht rather than a passenger steamship.

It is not contemplated to carry any cargo with the exception of a few automobiles on the main deck forward and a small amount of refrigerated cargo such as tropical fruits, etc., in the refrigerator compartments below decks. To facilitate the loading and discharging of the automobile cargo carried forward, a large auto port has been provided in the side of the vessel. This port is of sufficient size to allow the largest limousine built to be driven aboard instead of being hoisted in the usual way.

GENERAL ARRANGEMENTS

As will be noted from Fig. 5, quarters for the deck officers and the wireless officers are located on the boat deck, as is also the wireless room. A card room, which is decorated in



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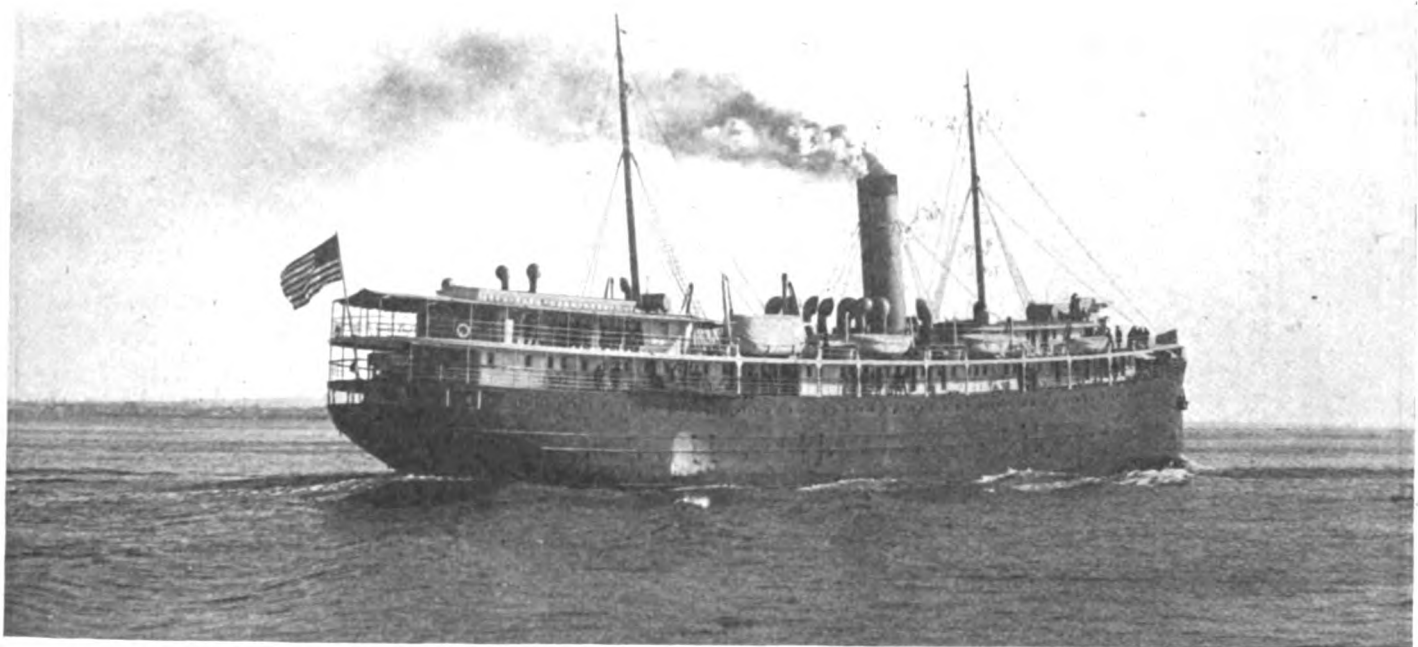
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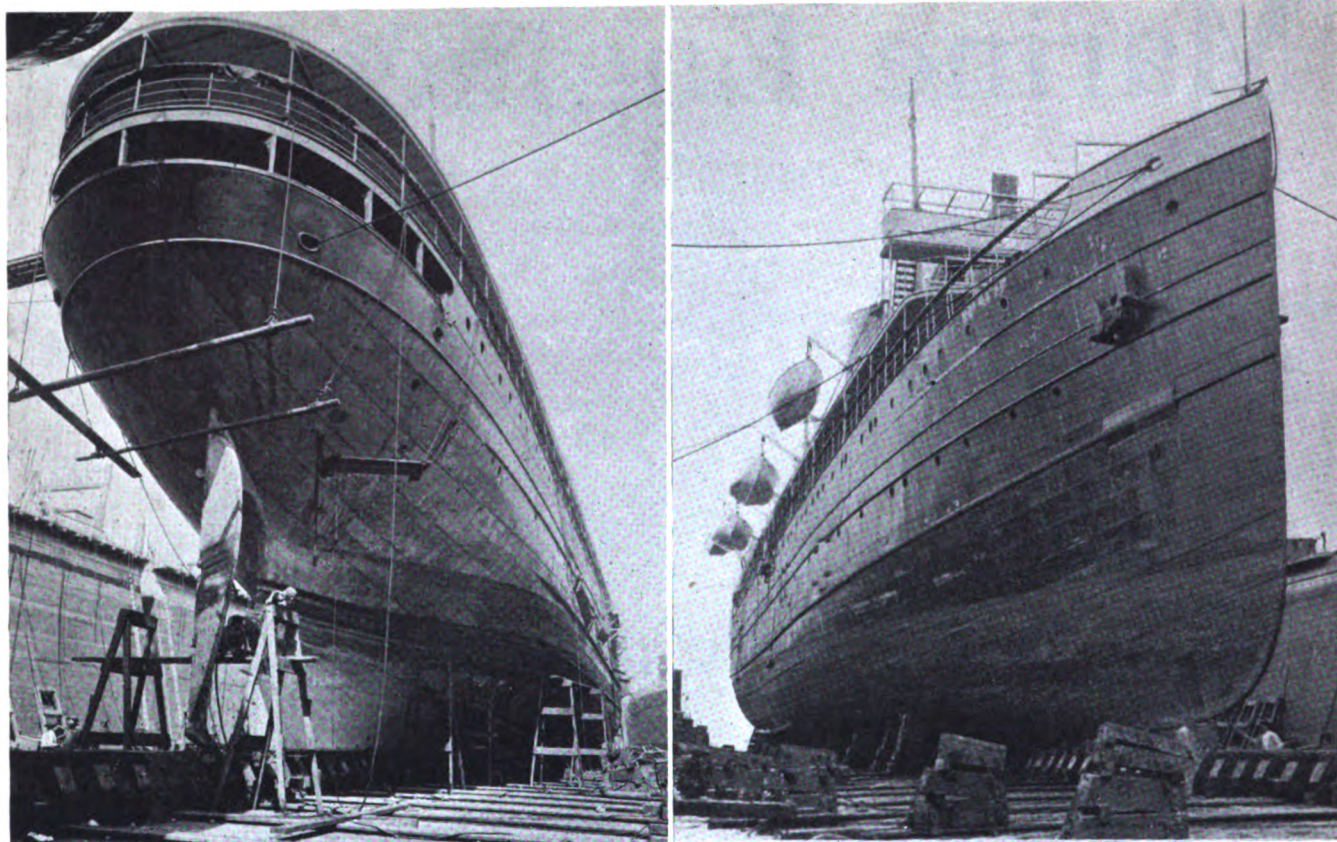
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(Photographs by Morse Dry Dock & Repair Company)

Figs. 2 and 3.—Views of the *Cuba* in Dry Dock, Showing Fine Lines of Vessel

white panel work with mahogany wainscoting and fitted with typical card tables, is placed aft of these quarters.

Farther aft on the boat deck is a smoking room with a large bar attached thereto, and aft of this a veranda café. The bar is completely fitted with a mahogany bar and a large ice box which is cooled from the ship's refrigerating plant. The smoking room is done in old English oak with a large skylight trunk extending the full length of the room. All furniture in this room is of wicker in a shade that matches the old English finish of this space.

The veranda café has been designed to represent as nearly

as possible, on board the ship, a typical veranda with running vines on trellis work. The windows, as will be noted from the detail plans, are exceptionally large, and when open one will derive the full benefit of the ocean breeze. The furniture in this space is quite attractive, being in ivory and green.

On the superstructure forward will be found the special staterooms which are fitted with double berths and private baths. The forward entrance hall on this deck is fitted in circassian walnut panel work and the after entrance hall with Crotch mahogany panels. All the staterooms are fitted with mahogany berths and furniture.

The dining saloon is designed for individual table service, each table being arranged for four or six persons. The chairs fitted are not of the ordinary ship revolving type, but are large comfortable tapestry upholstered chairs. A specially designed indirect lighting system is provided for the dining saloon, which adds considerably to its attractiveness.

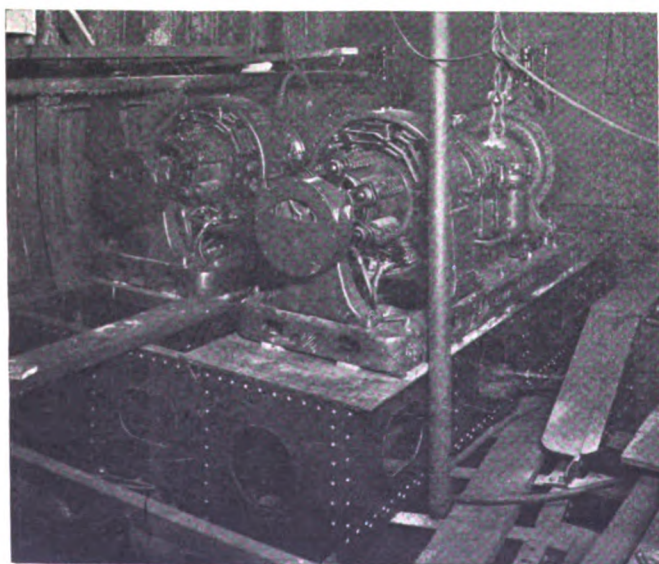
The galley and pantry are situated below the dining room and are equipped in the most up-to-date manner, including glass pantry, silver pantry, scullery, cold pantry and a bake shop with an electric oven as well as an electric roll warmer.

BOILERS

The boiler plant consists of four Scotch boilers 13 feet inside diameter and 10 feet 6 inches long, each with three furnaces of the Morison type. The length of grate is 5 feet 6 inches and the grate area for each boiler is 53.7 square feet. The boiler tubes are 2½ inches outside diameter and the total heating surface for each boiler is 1,900 square feet. The boilers operate at a pressure of 190 pounds and are fitted with the White Fuel Oil Company's system of oil burners and with superheaters furnished by the Locomotive Superheater Company, which deliver steam at a superheat of 200 degrees.

FUEL OIL

A fuel oil capacity of 1,772 barrels is provided for the



(Photograph by Morse Dry Dock & Repair Company)

Fig. 4.—Two 150-Kilowatt Exciters

vessel. This oil is carried in tanks built separate from the hull and located just forward of the boiler room.

FORCED DRAFT

A scheme for ventilating the turbo generator and motor and supplying the preheated air to the boiler has been developed on this vessel and during the trials it proved very efficient. By a series of dampers in the various ducts the hot air is taken from the motor and from the turbo generator and delivered through a 25,000 cubic foot per minute American Sirocco fan to the boilers at a mean pressure head of three inches.

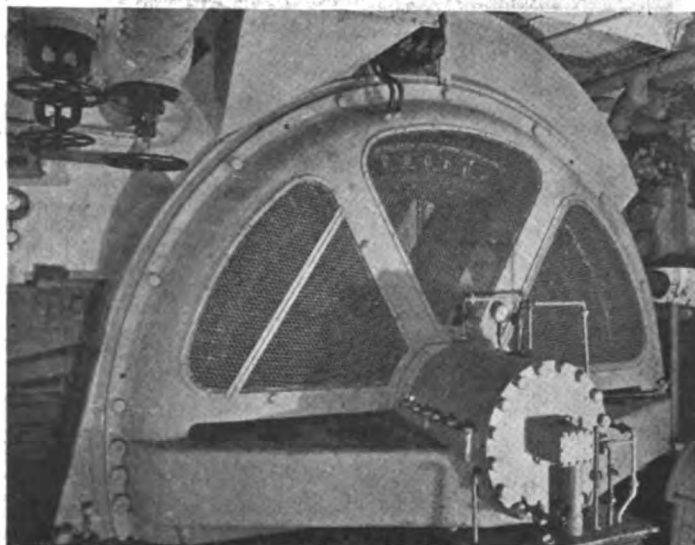
An auxiliary American Sirocco fan supplied by the American Blower Company, Detroit, Mich., has been placed in the after end of the engine casing to provide means for cooling the motor in case of breakdown of the large fan. This fan will discharge the air directly overboard, and in case of insufficient ventilation in the engine room it is used as an exhaust fan.

MAIN PROPELLING MACHINERY

The main propelling machinery consists primarily of a turbo generator, main propulsion motor, two exciters, control equipment and a lighting set. A general description of the operation of the electric propulsion machinery of the *Cuba* follows:

The turbine drives the alternating current generator which supplies current to the synchronous motor through a three wire system. The necessary excitation current for the main generator and motor fields is furnished by one of the exciters, which also supplies the light for the boat and power for the auxiliaries.

The control equipment enables the engineer to maneuver

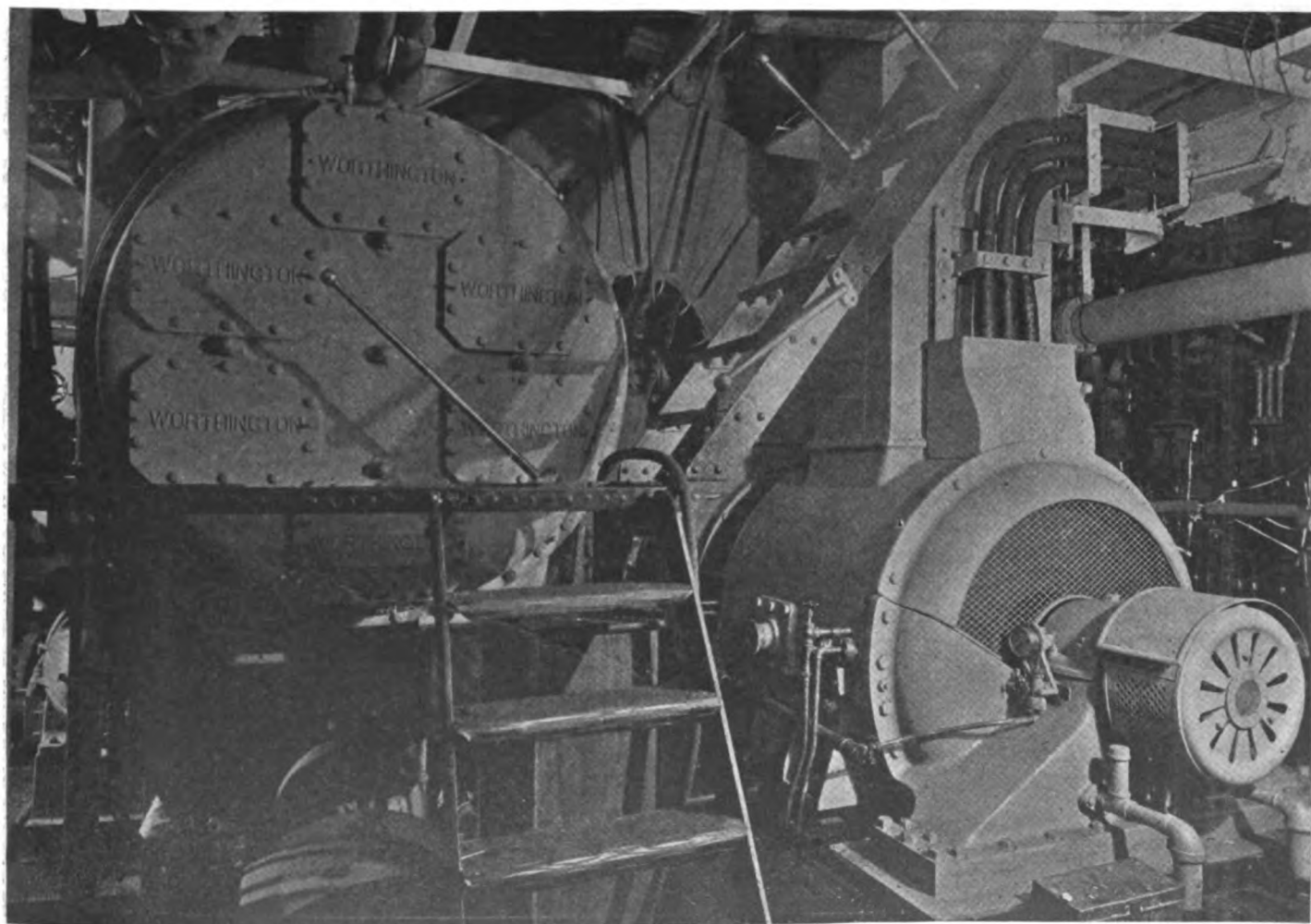


(Photograph by Morse Dry Dock & Repair Company)

Fig. 9.—Propelling Motor

by simply operating two levers, one for reversing and one for varying the speed. The motor is started, stopped and reversed by means of the high and low voltage contactors of the control group. In starting from rest, the motor operates without its direct current field as an induction motor. When the motor is nearly up to speed field is applied and operation continues as a synchronous motor.

In reversing, the motor is automatically connected to function as a generator returning power to the turbo generator,



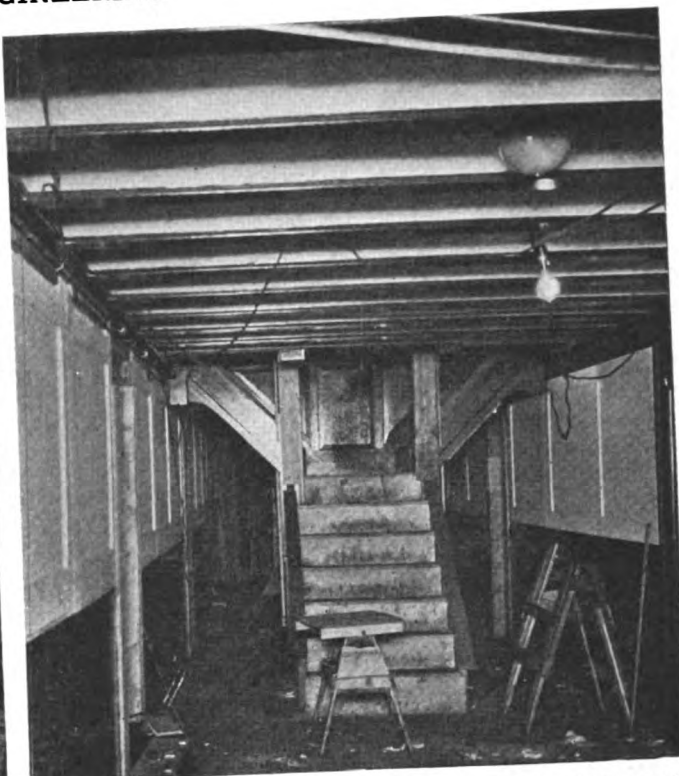
(Photograph by Morse Dry Dock & Repair Company)

Fig. 8.—View of Engine Room. Showing Main Turbo Generator and Condenser



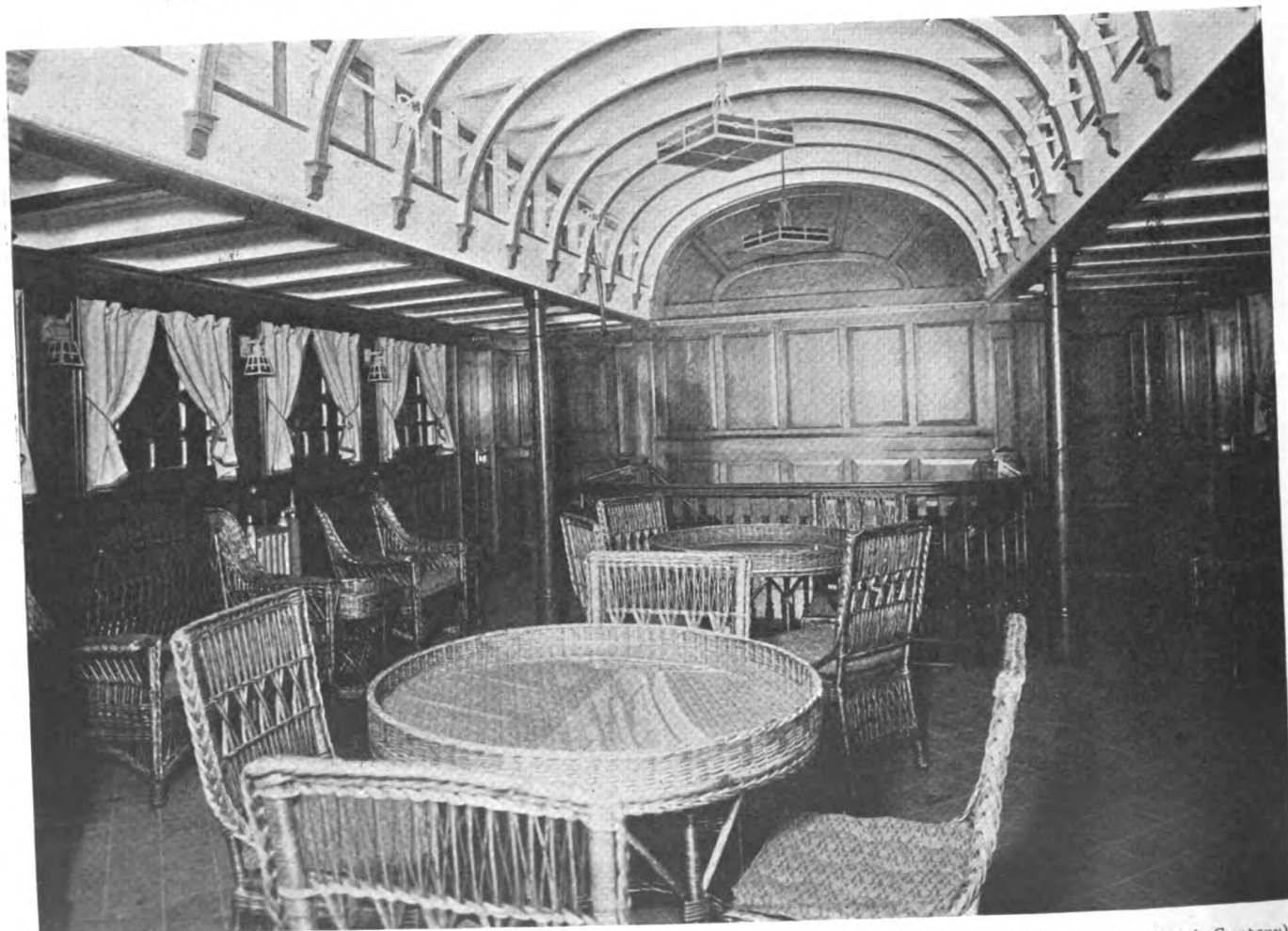
(Photograph by Morse Dry Dock & Repair Company)

Fig. 10.—Stairway Under Construction



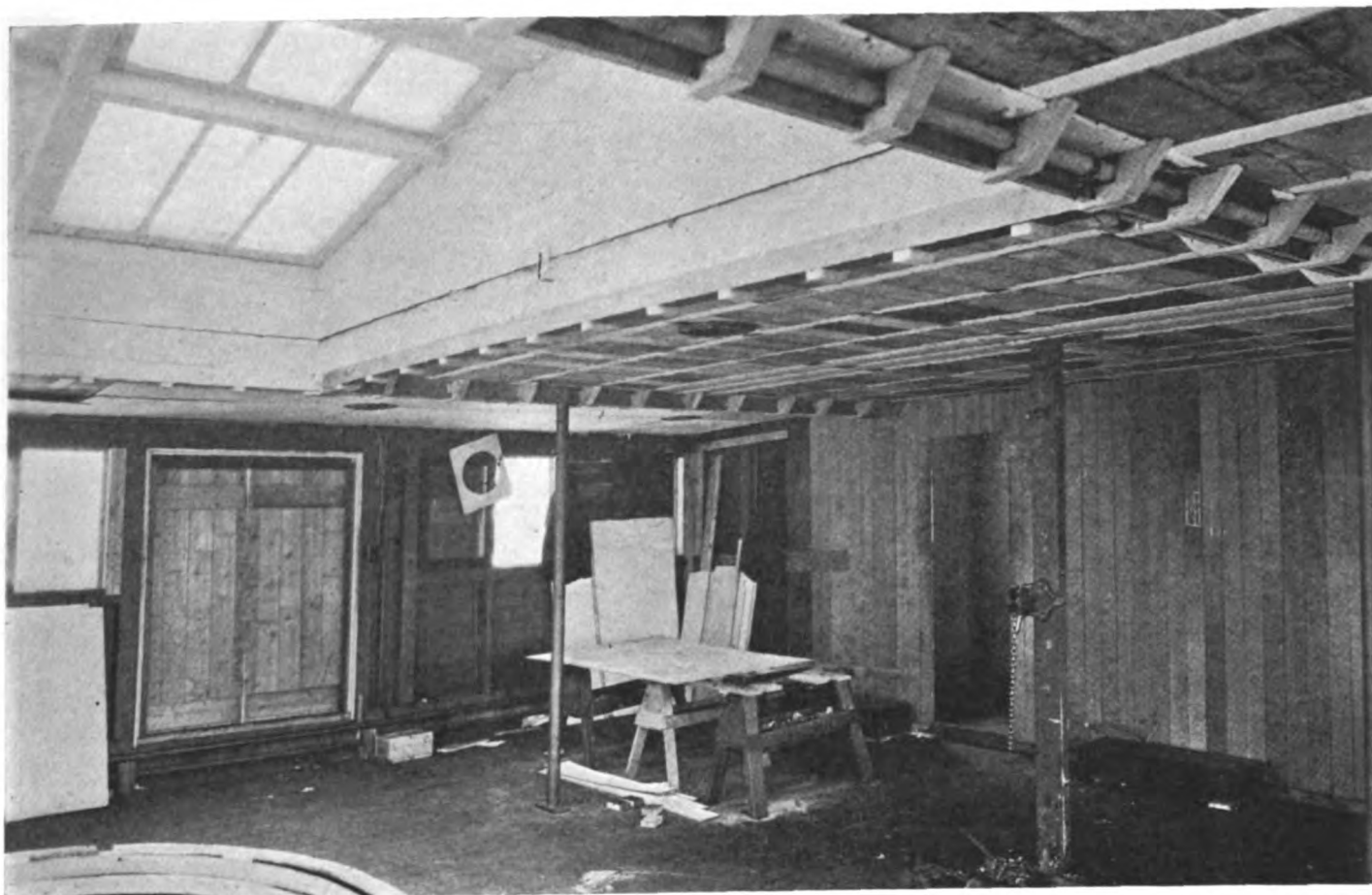
(Photograph by Morse Dry Dock & Repair Company)

Fig. 11.—Stairway and Panel Work in Passageway



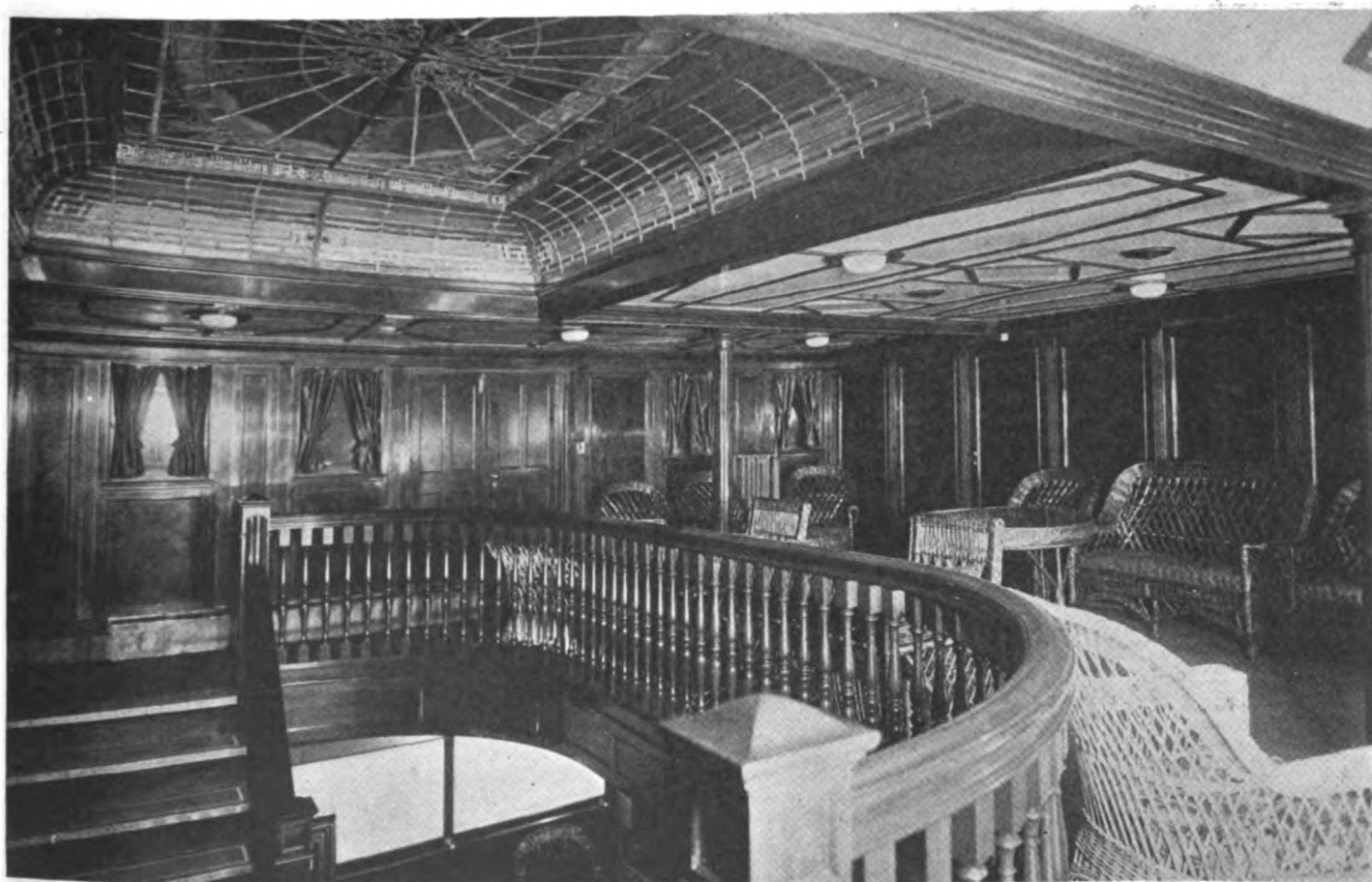
(Photograph by Morse Dry Dock & Repair Company)

Fig. 12.—Smoking Lounge



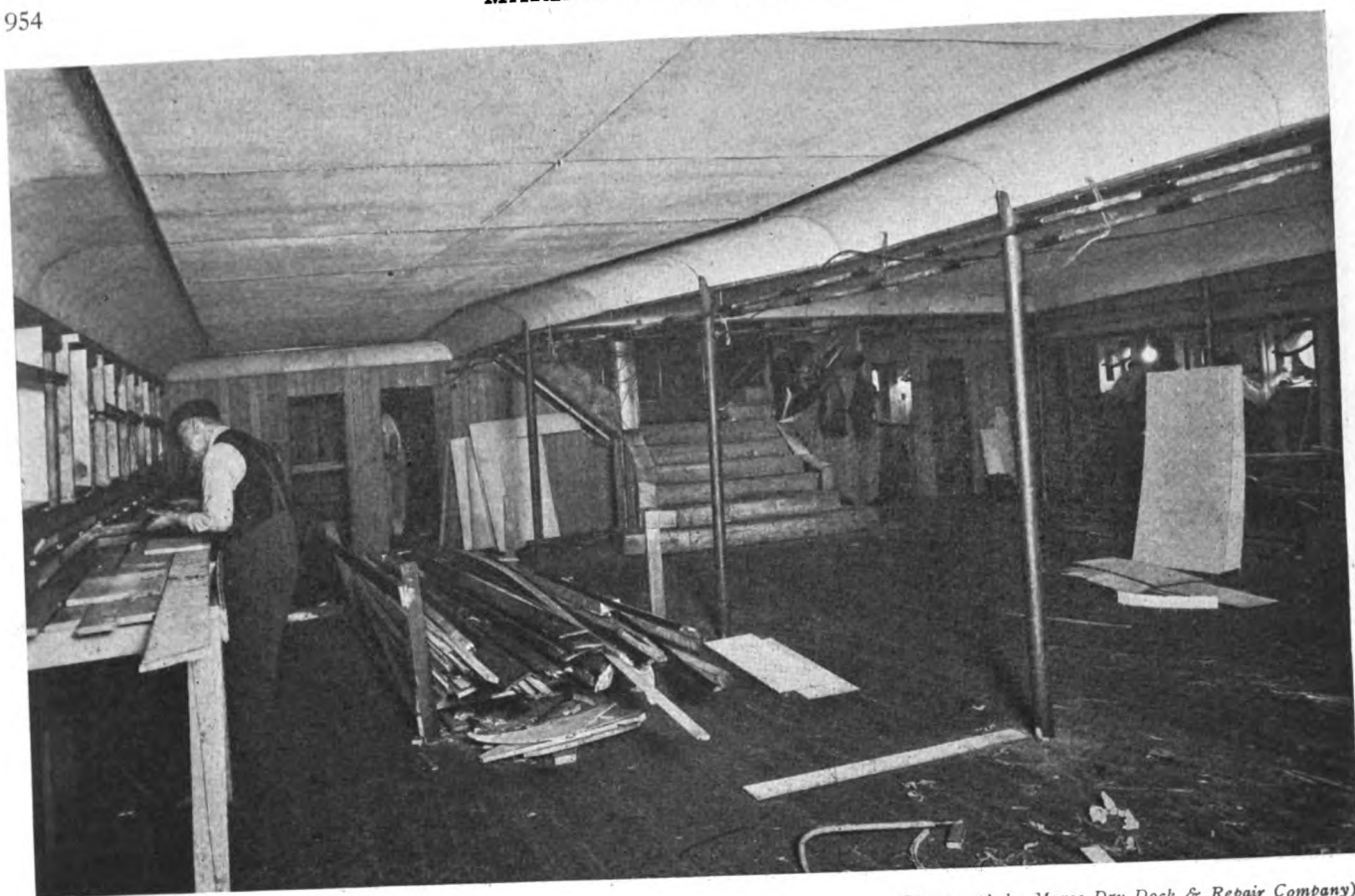
(Photograph by Morse Dry Dock & Repair Company)

Fig. 13.—Foyer on Superstructure Deck Under Construction



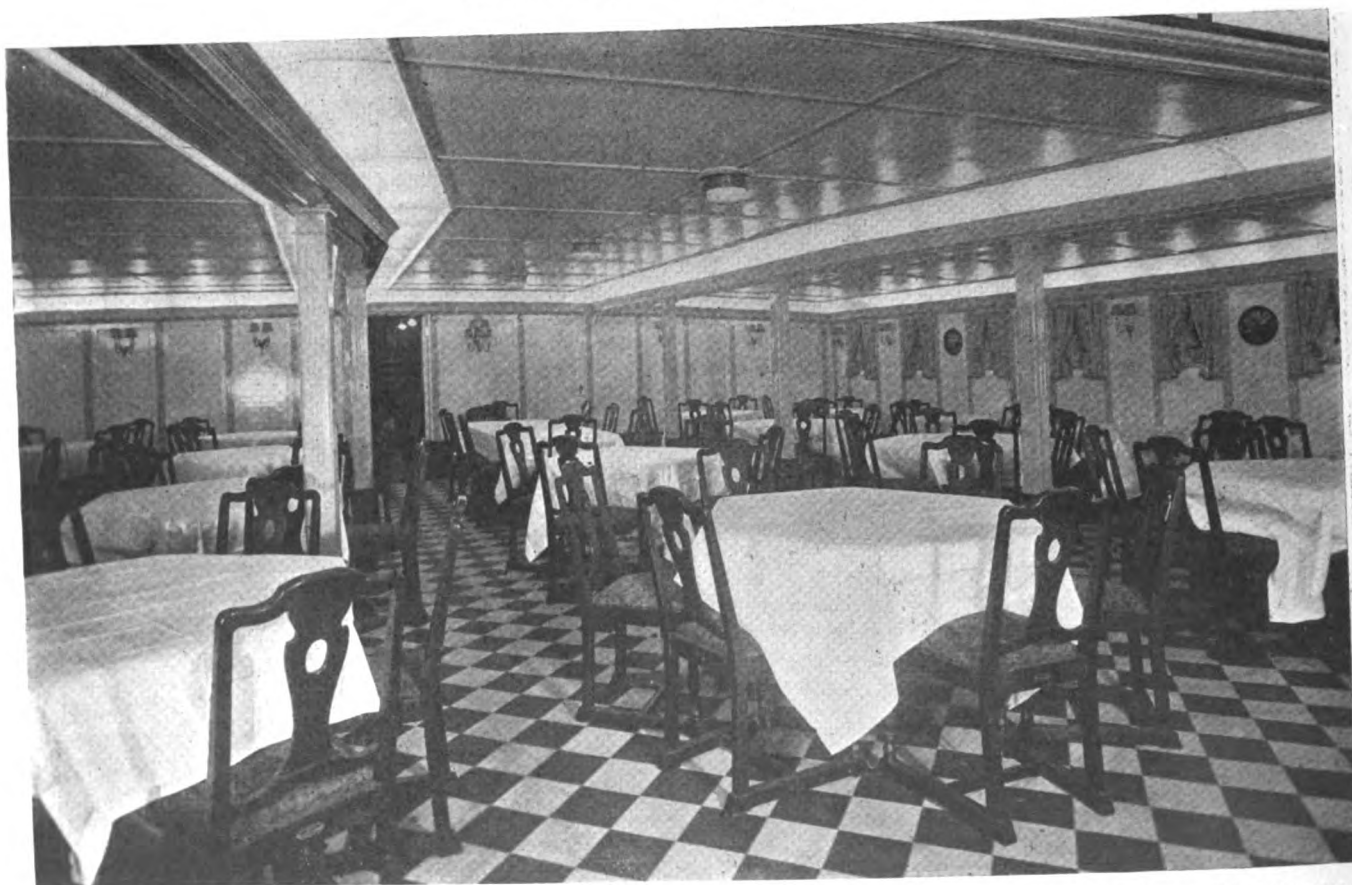
(Photograph by Morse Dry Dock & Repair Company)

Fig. 14.—Foyer on Superstructure Deck



(Photograph by Morse Dry Dock & Repair Company)

Fig. 15.—Dining Saloon Under Construction



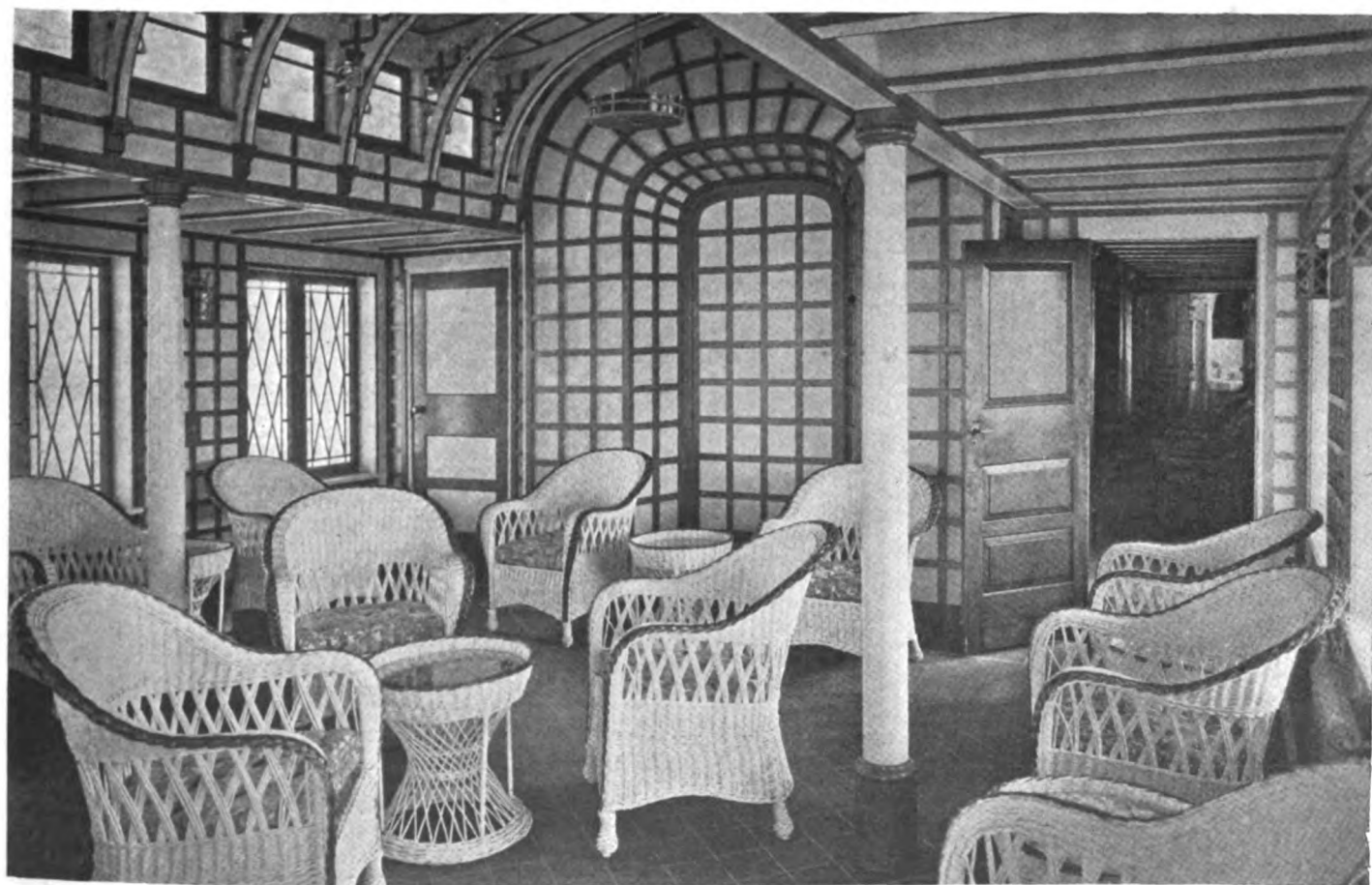
(Photograph by Morse Dry Dock & Repair Company)

Fig. 16.—Dining Saloon



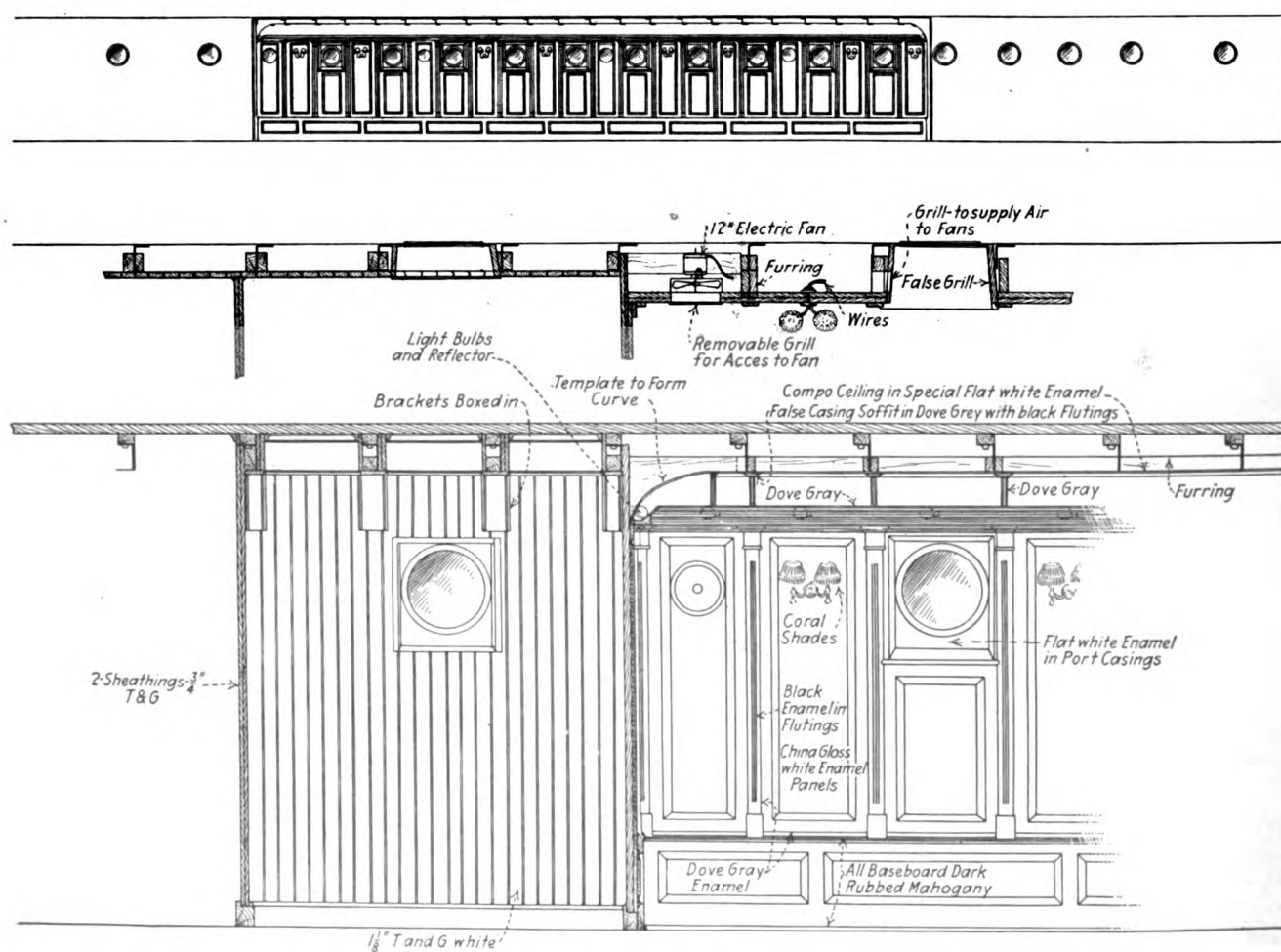
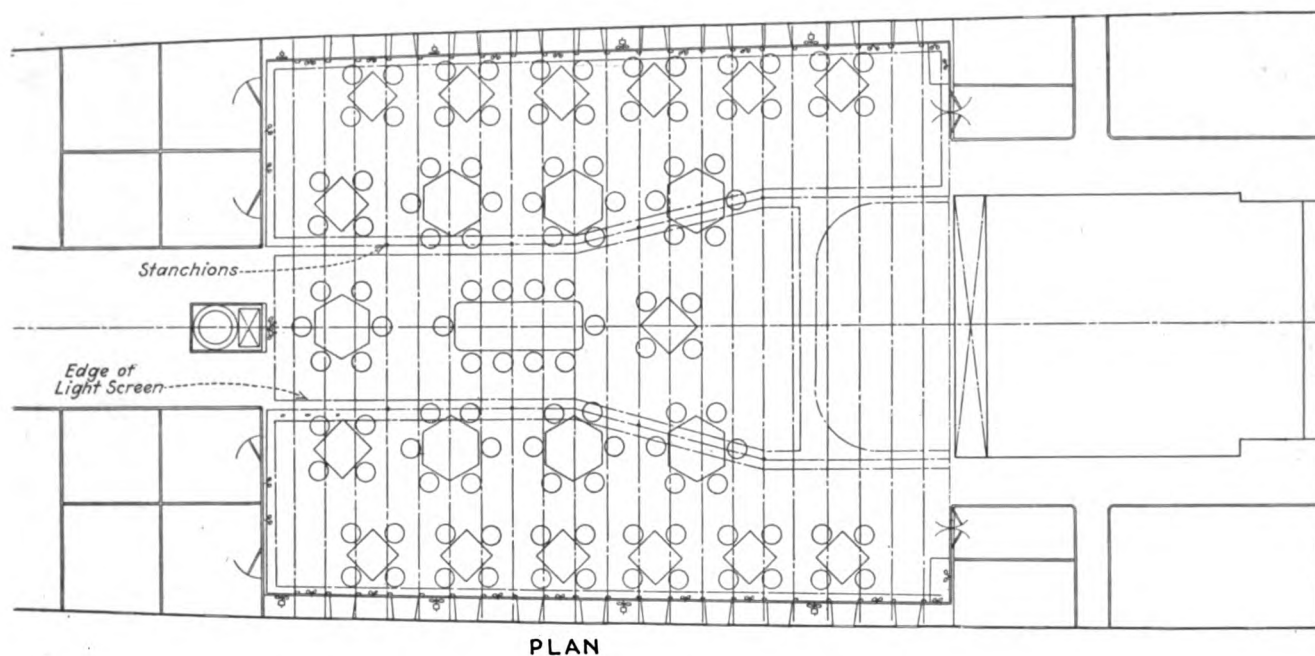
(Photograph by Morse Dry Dock & Repair Company)

Fig. 17.—Veranda Café Under Construction



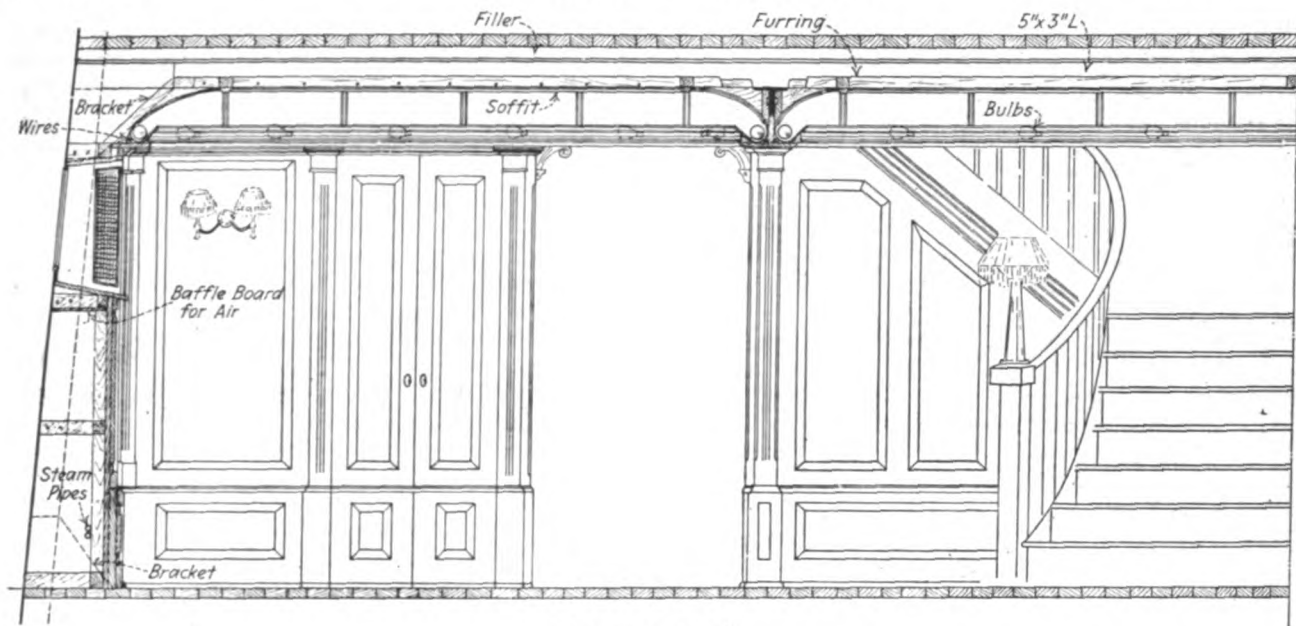
(Photograph by Morse Dry Dock & Repair Company)

Fig. 18.—Veranda Café After Completion

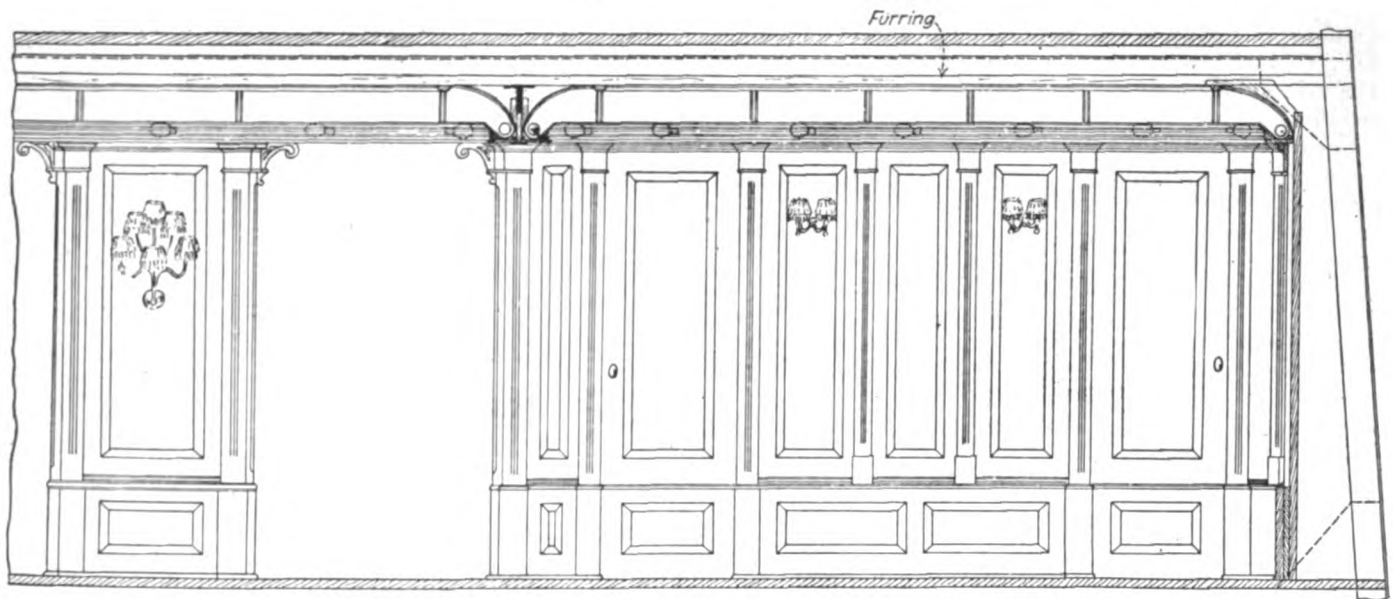


LOOKING OUTBOARD PORT SIDE

Fig. 19.—Dining Saloon: Plan and Elevation, Showing Joiner Details



LOOKING FORD



LOOKING AFT

Fig. 20.—Dining Saloon: Joiner Details at Forward and After Ends

which meanwhile operates without its direct current field, thus electrically braking the motor and bringing the propeller approximately to rest. It then operates as an induction motor to start the propeller in the reverse direction, and finally as a synchronous motor.

The principal characteristics of the main propelling machinery are as follows:

A Worthington Pump & Machinery Company, New York, surface type condenser having a cooling surface of 7,000 square feet is installed, with a length over the covers of 14 feet 10 inches and a shell diameter of 6 feet 1½ inches.

The main condenser circulating pump motor, supplied by the General Electric Company, drives a Worthington centrifugal type pump. The motor rating is 230 volts, 94/187 amperes, 25/50 horsepower, 800/1,000 revolutions per minute, while the pump rating is 7,000 gallons per minute against a 16-foot head. The diameter of the suction is 20 inches and the diameter of the delivery pipe to the condenser is 16 inches.

A gravity, direct pressure, combined lubricating system of the Worthington-Blake-Knowles type is used. A single cylinder pump having a steam cylinder diameter of 6 inches, an oil cylinder diameter of 6 inches, and a stroke of 12 inches actuates this system.

Two multi-whirl type oil coolers were supplied by the Griscom-Russell Company of New York.

A DeLaval oil purifier, having a rating of 100 to 120 gallons per hour, is also installed.

The turbo generator set of the horizontal, high pressure, 8-stage, impulse, condensing type built by the General Electric Company has a rated horsepower of 3,350 and a speed of 3,000 revolutions per minute. Current is generated by the unit at 1,100 volts and 1,234 amperes. The generator rating is 2,350 kilowatts.

The main propelling motor is of the General Electric synchronous type with a rated horsepower of 3,000, running on alternating current of 50 cycles, 1,180 amperes, 1,150 volts and having a forced system of ventilation.

Two General Electric turbo generator sets of 150 kilowatts each are installed for excitation and lighting. Each unit consists of a 300-horsepower turbine running at 3,600 revolutions per minute, driving a 150-kilowatt generator through reduction gears made by the Poole Engineering and Machine Company, Baltimore, Md., at 1,200 revolutions per minute. The generators are rated at 600 amperes and 250 volts.

The main switchboard, supplied by the General Electric Company, contains one main control panel and three exciter

panels with seven power circuits installed in the engine room.

A $\frac{1}{2}$ -kilowatt, 2,500 revolutions per minute motor generator set made by the Holtzer-Cabot Electric Company, Boston, Mass., has been fitted on the upper deck for supplying current to the wireless at 120 volts and 500 cycles. A spare steam driven lighting set is installed in the main engine room. This set consists of a 50-kilowatt, 3,600 revolutions per minute, 2-stage General Electric condensing turbine, driving a 4-pole, compound wound interpole machine at 3,600 revolutions per minute, which generates current at 400 amperes and 125 volts.

An emergency lighting set driven by a four cylinder gasoline engine built by the Universal Motor Company, Oshkosh, Wis., is located on the upper deck. The generator for this set is a 2-wire, 8-pole, compound wound machine, manufactured by Kurtz & Root, Appleton, Wis. The speed of the unit is 1,150 revolutions per minute. It generates current at 110 volts and 37 amperes.

Forced draft ventilation for the main motor is obtained by means of a squirrel cage type American "Sirocco" fan made by the American Blower Company, Troy, N. Y. The impeller of this fan is 12 inches and the outer diameter of the impeller 1 foot 8 inches. The fan is driven by a General Electric $12\frac{1}{2}$ -horsepower motor, running at a speed of 800 revolutions per minute with a voltage of 125 and an amperage of 875.

The capstan, supplied by the American Engineering Company, Philadelphia, Pa., is driven by a General Electric 20-horsepower, compound wound reversing motor, rated at 160 amperes, 115 volts, running at a speed of 1,150 revolutions per minute. An electric type deck winch is installed with spur gear drive. This winch was made by the American Engineering Company. This company also supplied a spur gear type anchor windlass provided with two gypsy heads for warping. This windlass is of sufficient capacity to handle the two 5,110-pound bower anchors and chains with which the ship is equipped.

An American Engineering Company steam and hand control steering gear is installed. The steam engine for the steering gear has two cylinders, each 7 inches in diameter and 7 inches stroke. A "Sirocco" centrifugal American Blower Company fan having a diameter of 3 feet 7 inches and a width of 2 feet 3 inches, with a steam cylinder 7 inches in diameter and 7 inches stroke is installed in the assisted draft system.

The auxiliary equipment includes:

A main condensate Worthington 2-stage hot well pump, driven by a 10-horsepower General Electric motor, running at 1,150 revolutions per minute.

Two 9 cubic feet capacity Worthington air ejectors with inter-cooler and after-cooler installed.

An auxiliary condenser of the Worthington type, having a cooling surface of 800 square feet, a length over covers of 13 feet 3 inches and a shell diameter of 30 inches.

An auxiliary circulating pump of the Worthington simplex horizontal type, having a steam cylinder diameter of 10 inches, a water cylinder diameter of 12 inches, and 12 inches stroke.

An auxiliary air pump of the Worthington simplex horizontal type, having a steam cylinder of 10 inches diameter, an air cylinder of 12 inches diameter, and a stroke of 12 inches; diameter of air duct is 5 inches at intake and at discharge 4 inches.

A main boiler feed pump of the Blakes-Knowles simplex vertical type, having cylinders 10 inches by 7 inches and a stroke of 24 inches, with a 4-inch suction and $3\frac{1}{2}$ -inch diameter discharge.

An auxiliary feed pump, also of the Blake-Knowles simplex vertical type, steam and water cylinders of 10 inches and 7 inches diameter and a stroke of 24 inches, a 4-inch suction and a $3\frac{1}{2}$ -inch discharge.

A bilge pump of the duplex horizontal type, made by the Epping-Carpenter Pump Company, Pittsburgh, Pa., having steam and water cylinders of 12 inches and $8\frac{1}{2}$ inches diameter, and a stroke of 12 inches.

A sanitary pump of the Worthington duplex horizontal type, having steam and water cylinders $7\frac{1}{2}$ inches by $7\frac{1}{2}$ inches and a stroke of 6 inches.

A fresh water pump of the Blake-Knowles simplex horizontal type with steam and water cylinders $5\frac{1}{2}$ inches by $5\frac{1}{2}$ inches by 7 inches stroke.

An auxiliary bilge pump of the Worthington duplex horizontal type, having steam and water cylinders 6 inches by $5\frac{3}{4}$ inches and a stroke of 6 inches.

A fire pump of the Epping-Carpenter duplex horizontal type 12 inches by $8\frac{1}{2}$ inches by 12 inches.

A feed water heater of the closed multi-whirl type made by

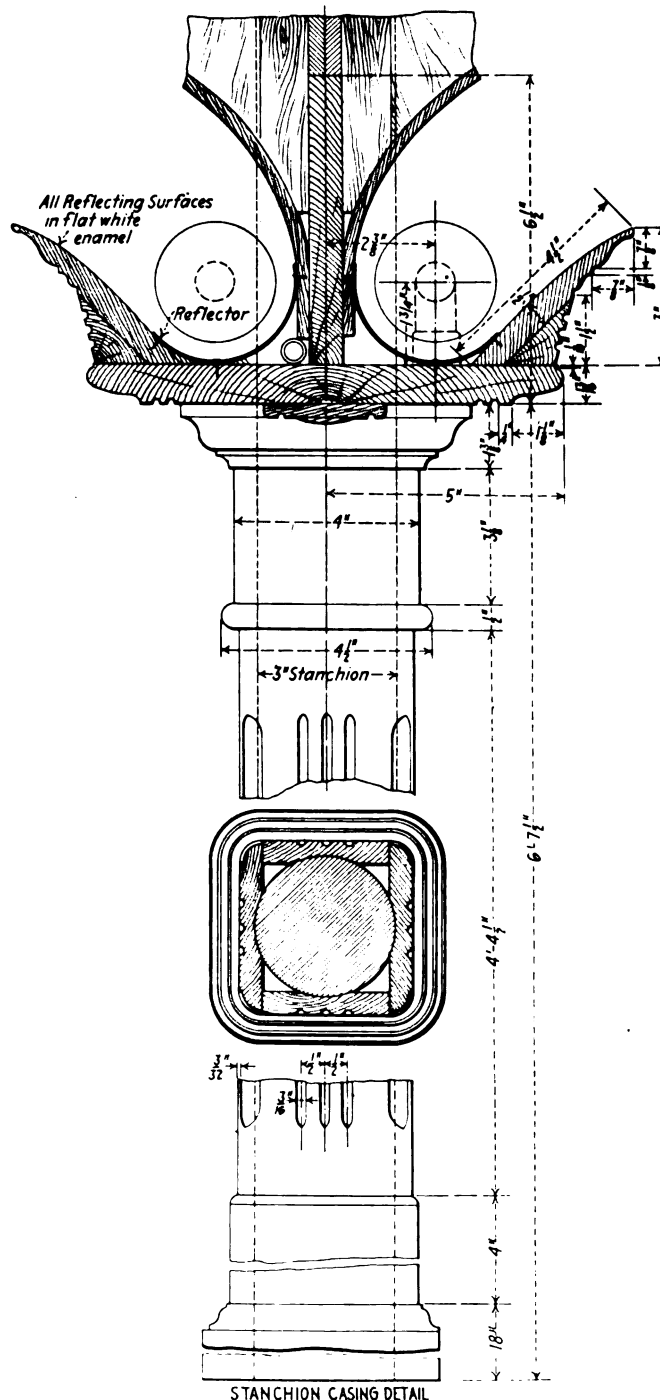


Fig. 21.—Detail of Stanchion Casing in Dining Saloon

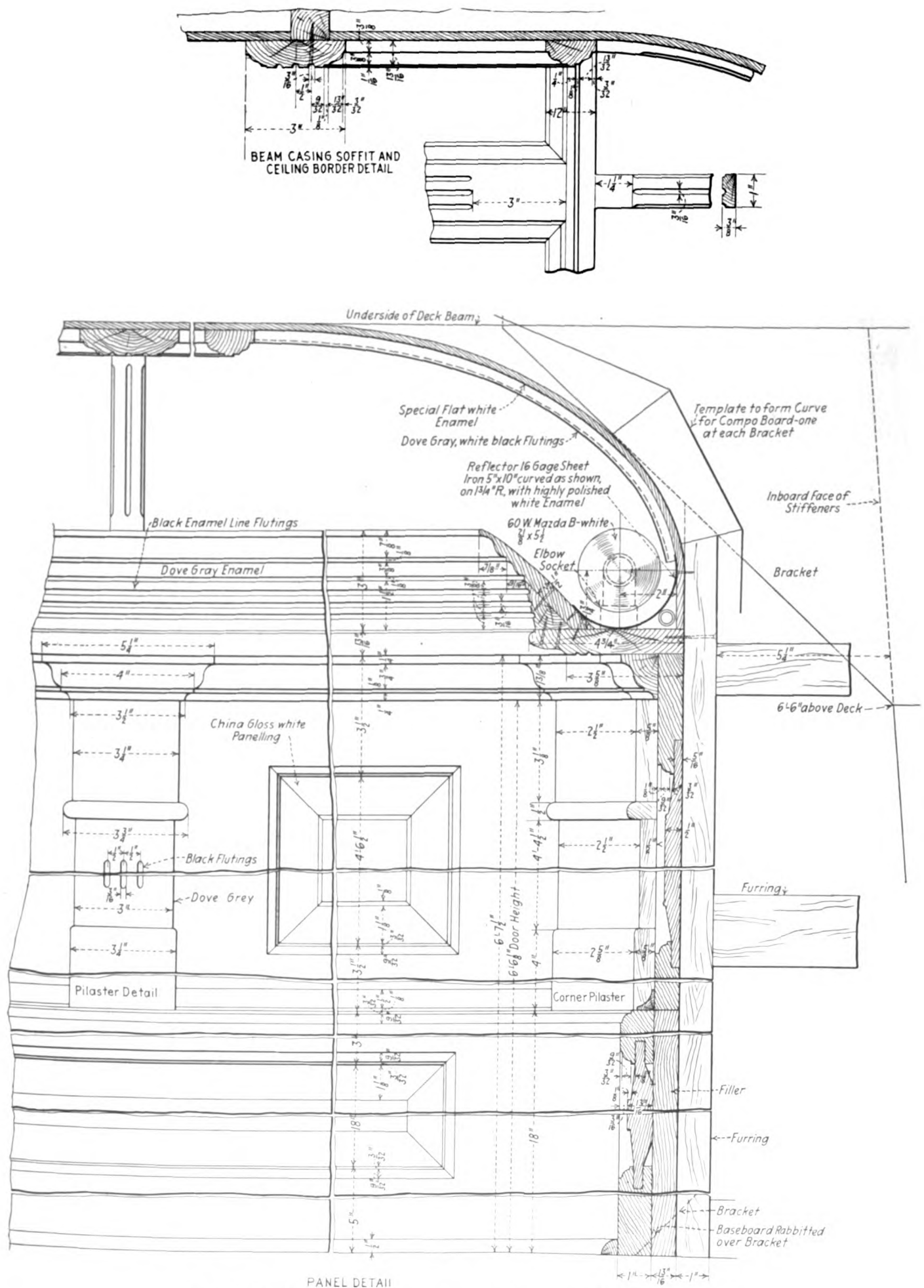


Fig. 22.—Panel Detail in Dining Saloon, Showing Construction for Indirect Lighting



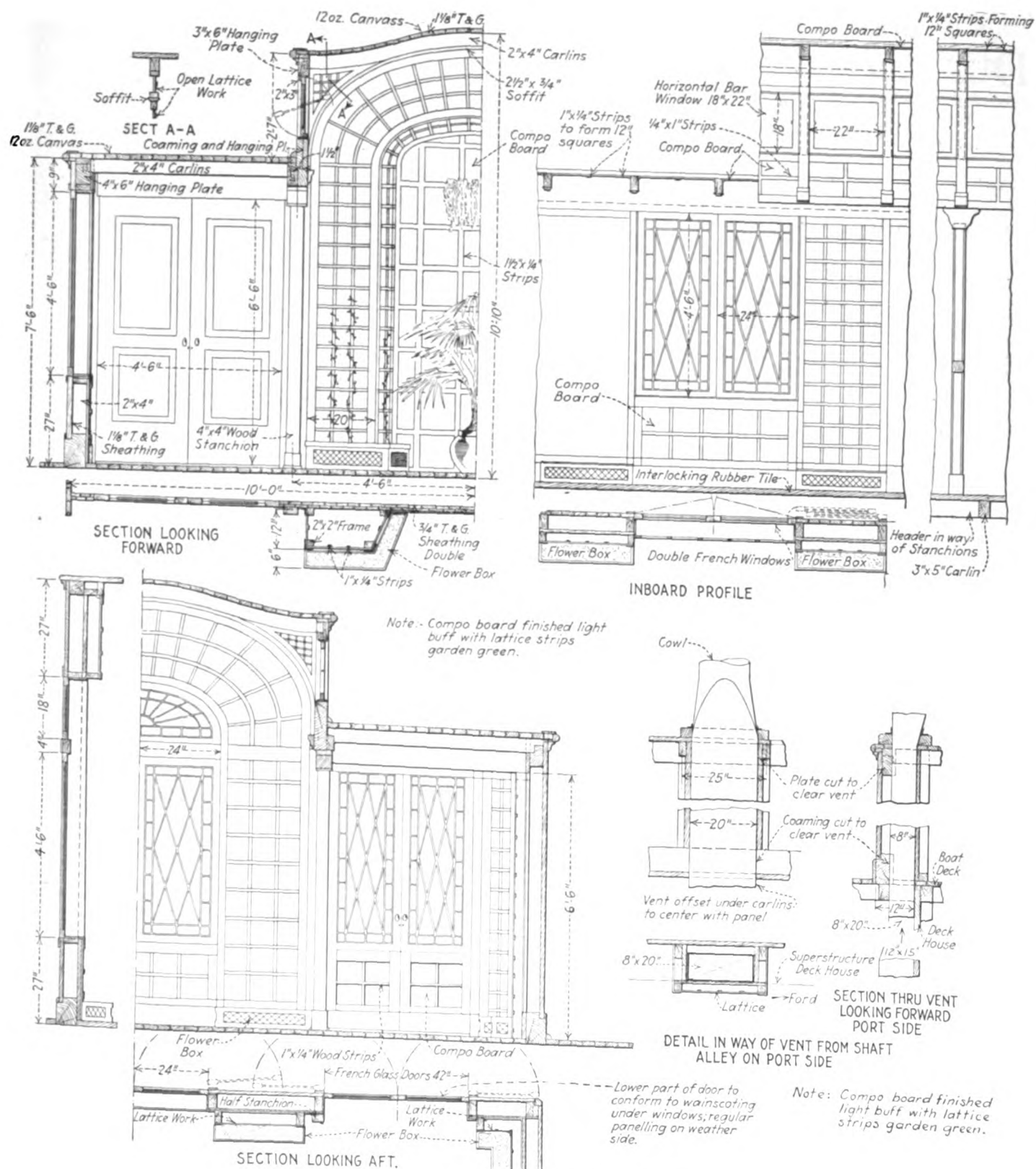


Fig. 24.—Details of Joiner Work in Veranda Café

the Griscom-Russell Company, of New York.

The vessel is supplied with a built-up type propeller with a cast iron hub and four manganese bronze blades. The characteristics of the wheel are as follows:

Diameter, 15 feet; pitch, 18 feet 9 inches; projected area, 52.32 square feet; developed area, 70.06 square feet; disk area, 176.71 square feet; projected area divided by disk area, 0.296; developed area divided by disk area, 0.396.

The propeller was supplied by the Columbian Bronze Corporation and was balanced to within two pounds. The blades are arranged for a variable pitch of 6 inches.

The lifeboats are of the American Balsa standard type and comprise two 20-foot metallic lifeboats, six 24-foot standard metallic lifeboats and two 24-foot Lundin boats.

The deck machinery has been supplied by the American Engineering Company, of Philadelphia, and comprises an electrical capstan, steam steering gear and anchor windlass, previously mentioned.

There is a deck winch fitted for taking care of the refrigerated cargo. This winch is electrically driven.

Two 8-ton Brunswick refrigerating machines are installed on the deck forward.

Cleaning Drain Pipes

DRAIN pipes on board ship often become plugged and great trouble is experienced in cleaning them. A pipe plug is generally fitted in the line for cleaning, as

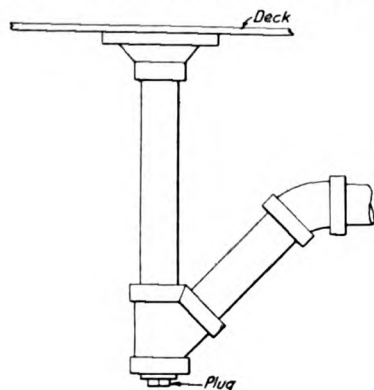


Fig. 1

shown in Fig. 1. In the majority of cases, however, it is in a cargo space or a bunker, and so impossible to get at.

The only thing to do in such a case is to insert a wire through the deck drain or use the fire hose with a nozzle and force the obstruction through. In the latter method it is necessary for one man to crawl into the drain and hold the nozzle, which has been wrapped carefully with packing

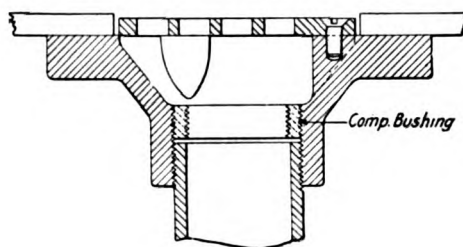


Fig. 2

to keep it tight, and for two others to tend the valve and the pump.

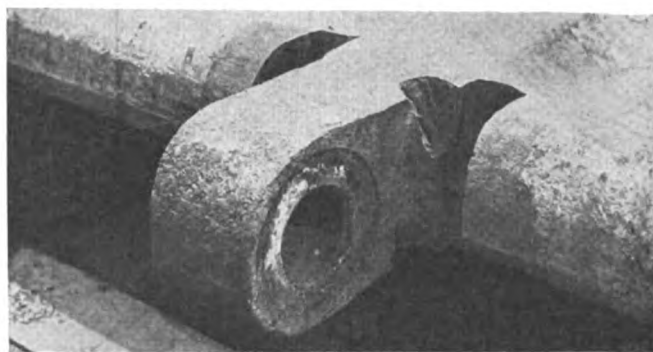
In the sketch, Fig. 2, is shown a cast iron body deck drain fitted with a composition bushing to keep the thread from rusting. A pipe nipple having a hose connection on one end may be screwed into the fitting and so connect the line directly to the fire main.

M. V.

Welding a Fractured Rudder Frame

WHEN the 4,341-ton Green Star Line freighter *West Grama* was recently placed in dry dock for repairs at the Robins Dry Dock & Repair Company, South Brooklyn, N. Y., the frame of her 9-ton cast-steel rudder was found to be fractured in four places. The fractures all extended from 8 inches to 10 inches into the chunky side of the casting. To replace the rudder by purchasing a new casting would have cost \$9,000, not including the cost of installing the renewal and the almost inestimable loss due to the idleness of the vessel while awaiting delivery of a new rudder, which would have taken about four months. It was therefore decided to repair the rudder frame by thermit welding.

In making this repair, the rudder was unshipped and laid on the dock with the frame in a horizontal position. The metal surrounding the four breaks was then cut out with an oxy-acetylene torch and chipped with a pneumatic chisel, so that four gaps, each about 3 inches in width, were made in order to provide space for the thermit steel later to enter, as shown in the illustration. The usual steps customary in thermit welding were then followed.



View of Two Breaks After Fracture Was Cut Out with Oxy-Acetylene Torch and Chipped with a Pneumatic Chisel

As the fractures in this particular repair extended only partly across the casting, it was necessary during preheating to offset contraction strains by heating the ribs at the ends of which the welds were located.

Each pair of welds was poured simultaneously, as the pattern wax had previously been shaped so as to connect the two gaps in each pair of welds. For the whole job 450 pounds of thermit in each of the two crucibles were used. The welds were completed within five working days after the fractures had been cut out and were reported to be satisfactory in every respect.

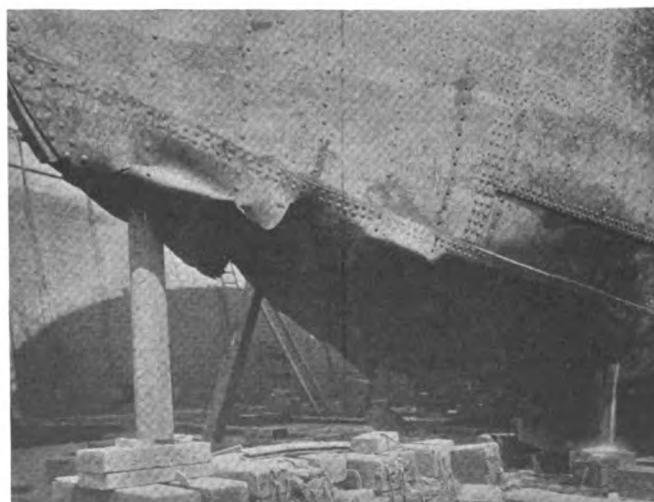
Repairs to the Willdomino

WHILE in the last leg of a voyage from Palermo and other Mediterranean ports to this side of the Atlantic, the *Willdomino*, a British vessel, having a length of 410 feet 6 inches, struck an uncharted rock off Canso, Nova Scotia. She was then towed to New York and drydocked at the Tietjen & Lang Dry Dock plant of the Todd Shipyards Corporation, Hoboken, N. J.

When the vessel was lifted out of the water it was found that the shell plating had been badly smashed from the bow aft to the forward collision bulkhead. This bulkhead was twisted as well, so that No. 1 hold had been flooded.

Although the plates were crumpled at the forefoot only, both the frames and the plating were badly twisted above the waterline and aft a distance of several stations. As a result, the entire bow had to be more or less reconstructed.

The work of fitting a new forefoot on the *Willdomino* is now nearing completion and the vessel will soon be ready for her return trip to the Mediterranean.



Damaged Forefoot of S.S. *Willdomino* Sustained by Striking Uncharted Rock Off Canso, Nova Scotia

Bolting-up in Ship Construction

Establishment of Standards and Introduction of Piece Work Result in Marked Savings in Construction

BY F. T. WARNER*

WITH the ending of the war and the main consideration of shipbuilders drawn from speed to economy, many improvements in methods were made. Articles in shipbuilders' journals would indicate that not every manager has taken even the first steps on some of the simplest improvements. For instance, the thought behind one recent article describing the success of spray painting in ship construction would seem to be that some shipyards might not have overcome the few obstacles in the way of this excellent scheme and that it was published for their benefit. It is therefore possible that one man's experience with that much more involved and important problem of bolting-up would be at least interesting, if not beneficial.

IMPORTANCE OF BOLTING-UP

The importance of this phase of ship construction is known to most managers. In cost it represented during the war, in the large majority of American steel shipyards, from 15 percent to 25 percent of the cost of hull construction; bolting-up and riveting together from 30 percent to 45 percent of entire cost of hull construction.

The Standard Practice Bulletin No. 15 of the Emergency Fleet Corporation shows in Table 1 the actual number of employees engaged in several trades in seventeen shipyards during the war period. This table is useful in showing that the writer's experience is not unusual in regard to the ratio of number of men employed in one trade to that of another trade, it being assumed that cost ratio will approximate the ratio of number of men employed.

Not only during the war, but for some time after, thought and energy seemed to be centered in riveting. Records of riveting were everywhere published for the object of improvement, if not, in fact, to settle wagers or contests. Therefore, with little or no considerable thought given to the equally important trade of bolting, the average yard emerged from war conditions to find one of their biggest costs was without check or control.

ESTABLISHMENT OF STANDARDS

The first step in obtaining the necessary control was the establishment of a work unit and standard of quality. Past experience in pre-war times showed the lineal foot of single seam bolted to be satisfactory to start with. We had the berthing system and had eventually to adjust this unit to the berth, so looking ahead there was nothing to fear in this respect.

As to quality, each seam had to be tight enough so as not to enable a knife to get between the members bolted. The knife selected was the pallet knife such as is used by artists. The blade is about one-half inch in width, and when new something less than ten one-thousandths of an inch thick. These knives, however, were used until worn out, but all the bolting had to be "knife tested inside and out," regardless of the age of the knife. From this it will be seen that the bolter had only to put in such bolts as were necessary to meet the test. Knives were provided for all workmen as well as inspectors or supervisors and charged out of stores to them in the same manner as other tools.

Standards being thus established, returns each day were made on stationery printed for the purpose, showing number of feet bolted, cost per foot and location of work, etc. The

ten ships each day that showed the highest cost of production were subjects of investigation.

REORGANIZATION

At this stage it seemed advisable to make some changes in the organization, especially to get things started. Previously, bolters reported to ship foremen, who were principally men who had been the best ship fitters. A bolter foreman was named and rated as assistant hull superintendent and given responsibilities similar to those of the general foreman riveter.

Under the bolter foreman came quartermen bolters and leadingmen bolters on each ship. The quartermen, however, reported direct to ship foremen in regard to location of their work and in matters other than those which would tend to improve bolting production, for which the new foreman bolter was responsible.

Additional inspectors and counters were added and the daily production slips were signed by them in triplicate. The original went to the gang of bolters, the second to the foreman bolter and the third to the time office.

It will be seen that while the poorest bolters were being investigated, which resulted in increased production and better work, the ground work was being laid for a piece work system.

INTRODUCTION OF PIECE WORK

At this time there were some few of the best men who had no scruples in regard to the stop watch, and we selected the very best of these men, who incidentally were the best in the yard, on whose work time studies were made. The results were very discouraging, as the cost of straight shell plating was over fifteen cents per foot for the first bolting and over this for changing bolts.

Many different bolting machines were also considered, but for regular bolting none was adopted.

After considerable study a simple classification was made and piece work prices set. These prices averaged less than 33 percent of the current costs at that time. With these prices went a guarantee of day's wages (at, of course, the Macy scale), in case the bolters did not earn over this on the piece work rates set. In other words, during the period of guarantee the bolters had nothing to lose but something to gain.

The thought behind this was that by the bolters only could corners be cut, and that if they tried hard to earn the piece work bonus they would eventually become expert and we would be enabled to set fair piece work prices. It might be well to state here that it has always been the policy of the management to consider as fair contract or piece work prices those averaging from 150 percent to 200 percent of the Macy wage, those lower being considered unfair to the workmen and those above too magnanimous. Also, in general, the management has been opposed to reducing piece work or contract rates, once established, except as the result of careful consideration and consultation with the workmen affected.

While with this first schedule it was not expected that workmen, except in most extraordinary cases, could earn bonuses, it was quite a surprise to find that in shop work they made exceptionally good and fairly so on certain ground assemble work. At that time plate shed punches not in use were fitted with dies for riveting and did good work. In this,

* Plant manager, Virginia Shipbuilding Corporation, Alexandria, Va.

as in work going to bull riveters, bolts needed to be put in at intervals averaging about three feet and the knife test was not required because these heavy machines brought the steel members together in a way which hand tools could not. In consequence of this, therefore, a reduction agreeable to the men was made.

During this period, and up until the guarantee of day wages was withdrawn, the ten gangs showing the poorest production were investigated. But after the first schedule had been prepared we priced each gang's work according to piece work prices and their work was no longer rated as the highest in cost, but as that on which the company lost money as determined by the difference in what we paid on day's wages and earnings at the piece work rates.

SECOND SCHEDULE INTRODUCED

After this first schedule of piece work prices was a second by which every good workman in shop and on ground and some few on the ship could earn from 150 percent to 200 percent of days' wages except in most unusual cases. The classification was also condensed into some twenty-five items and the day's wage guarantee was extended for two months.

At this stage regulators were found to be helping the bolters. The duty of the regulator was to adjust correctly the steel members placed in position by erectors who were required only to secure it with sufficient bolts to make safe.

There was no way of defining the extent and quality of the regulators' work, but as it was so necessary to good bolting we decided to include the cost with the bolting in the general control. From then on the bolter foreman was advised daily of his "cost per foot bolted," and this included the regulating cost. Regulators are paid days' wages in accordance with the Macy scale.

The work of the ship fitter is usually confined to lifted work or in cases of miscellaneous foundations, etc., that work which is taken direct from plans. In contracts made with fitters their work ended with the erection of lifted work or with final bolting-up in the case of small assemblies.

The bolters and regulators make ready for reaming. When unbolted holes are reamed the bolters change the bolts, clean out any burrs and chips between plates, and do all "laying up" required. The schedules covered prices for each operation and the feet bolted originally were about double that actually existing to be bolted by reason of these two operations on each foot. This second bolting is now being largely dispensed with by furnishing a single reamer with a rivet gang, who takes out bolts and reams the holes originally bolted as he goes along. He has assistance of riveters when needed and is paid piece work, at the Macy scale for reamers. From this it will be seen that where originally there were twice the number of feet bolted than actually existed, due to two operations, this is considerably reduced. At present, in over half the work no bolts are changed and there is no second bolting done. In fact, in one recent ship the entire shell has been taken after the first bolting by the riveters having with gang one man to ream. The reamers, using small drilling machines for reaming, do all the work alone, removing the bolts with the help of riveters at no extra charge to company.

FINAL SCHEDULE ADOPTED

At the expiration of the two months' guarantee of day wages a third schedule of piece work prices was put into effect with no guarantee of day wages. Men who could not make the grade left the yard and were replaced by the best men from other yards which employed no piece work rates for bolting, the best men naturally wanting the piece work scheme.

Occasionally, when something unforeseen came up, "agreement prices" had to be made with the men, but each one was very carefully considered and when the work was finished the

unit cost compared with the way the men worked. This became the basis of another piece work price which was added to the schedule or included under one of the classification items to which the price most nearly applied. After two months there was not an average of one agreement a week necessary. To be sure, in such a limited number of groups as we established and under the varying conditions the days' earnings were quite irregular, but the men were steady workers and evened things up in a week's run.

PERSONNEL IMPROVED

Ordinarily the personnel of the bolting organization is on a par with the labor personnel. Under the scheme adopted it is very much improved. The method of counting in company with the workmen themselves at which time the production and unit price are given on the slips to workmen tends to do away with protests because only those are considered which are due to errors in computations by the time keeping department, a very few indeed.

The bolter foreman, so necessary at first, made a change to his advantage when the plan was running smoothly and has not been replaced. The supervisory force has been reduced and this reduction now offsets the increased cost of counting and the closer inspection required by piece work. About 5 percent of the bolters work single handed, and by so doing get the prices usually paid a two-man gang. The earnings of the bolters are less than those of any trade in which the piece work rates were set by the Macy Board, but the men are satisfied with bonuses and conditions.

The management deals with workmen through a craft committee, the scheme in effect during the war. Open shop exists, and for the last eight months no difference between the company and workmen has existed which has not been adjusted by foremen without having come to the attention of the management of the company.

RESULTS

An idea of the results obtained may be gained from the following cost, consisting of direct labor of all bolters and regulators, no leading men, as none is employed, and no indirect charges of any kind being included; the unit of production is the lineal foot of single seam bolted or rebolted:

January, 1920, cost per foot, 25 cents average.

August, 1920, cost per foot, 6 cents average.

While our cost in January might have been higher than the expenses of other shipyards, it is the opinion of the writer from many observations of the Atlantic shipyards that they were not. It should be noted that the costs are inclusive of the expense work done at the dry dock which cannot possibly in some cases be measured.

In this case the bolting is done by regulators at day-work wages and the cost is charged against other work that is measured.

CONCLUSION

In conclusion, a comparison of bolting cost to that of other properly controlled trades would further indicate the extent of the saving effected. The bolting cost is one-third of the riveting cost, and also less than fitting-up, ship carpentering, chipping and calking (including tank testing), all of which are well controlled as follows: Riveters 6 to 7½ cents per rivet; fitters and ship carpenters by contract work of known efficiency; chipping and calking by Macy scale piece work rates; and tank testers by contract and bonus.

The progress of development of this work would indicate that before another year has passed the cost of bolting should be less than 5 cents per foot and that 75 percent of the work would need no changing of bolts. Also, the plan, while at present being worked on several ships of a type, is easily applicable to any single steel ship that a yard may be called upon to build.

American Bureau Surveyors at Foreign Ports

IN accordance with the announced policy of extending its surveying facilities to all the principal seaports of the world where American ships are now trading in the extension of our foreign commerce, the American Bureau of Shipping, now the officially recognized classification society of the United States Government, is making careful analyses of port conditions and is assigning experienced surveyors as its representatives at such ports where the conditions warrant it. One of its vice-presidents is now engaged in visiting European countries and making recommendations based on the actual conditions found at each seaport. Already an exclusive surveyor has been detailed at Hamburg, who will have general supervision of the Bureau's interest at that and other important ports in the vicinity.

On November 6 Mr. Daniel Meyer sailed for Antwerp, where his headquarters will be located; from this point he will have general supervision of American classification duties in all ports of Belgium, and possibly Holland. Mr. George A. Browne will shortly sail for Havre and will be charged with looking after survey duties in northern France. Each of these gentlemen has had many years experience in shipbuilding and surveying, and each speaks the language of

the country to which he is assigned. Exclusive surveyors have also been appointed recently at Havana, Rio de Janeiro and San Juan to act as surveyors at those ports. An official of the Bureau will shortly visit all ports in the West Indies, Central and South America to ascertain the conditions and necessities for surveyors at the principal ports where American ships will call.

The policy of the Bureau is to have none but American citizens as its exclusive representatives abroad. Each surveyor will be charged with the duty of doing everything possible to facilitate the surveying of American ships classed in the Bureau, and in a general way to aid in every legitimate way the extension of American commerce at the port where he is assigned. Wherever possible, the surveyors will be taken from the experienced corps in this country, preference being given to those who can speak the language of the country to which he is assigned.

The Bureau now has the services of an experienced corps of non-exclusive surveyors in all the leading ports throughout the world, by its alliances with the British Corporation, the Registro Navale Italiano and The Imperial Japanese Marine Corporation. It is contemplated that at the less important ports arrangements will be made whereby exclusive surveyors may be maintained to represent the four allied societies.

Diesel Motor Yacht for Vincent Astor

Description of 160-Foot Steel Sea-Going Yacht Designed by Cox and Stevens and Equipped with Winton Diesel Engines

A NEW Diesel motor yacht of unusual interest is under construction at the yard of Robert Jacob, City Island, New York, for Mr. Vincent Astor. The vessel, which is of the sea-going type, is being built from designs by Cox & Stevens, naval architects, New York. The principal dimensions of the hull are as follows:

Length overall	160 feet 8 inches
Beam, molded	25 feet 0 inches
Depth, molded	15 feet 0 inches
Draft	10 feet 0 inches

QUARTERS

The deck house contains a large dining saloon at the forward end with a galley and pantry directly aft. Aft the engine enclosure a smoking room, 14 feet long by 12 feet wide, is provided on the port side and an entry from the main deck with stairs to the owner's room on the starboard side. Next in order is the living room, which is large and commodious, being 22 feet long by 18 feet wide. Both the living and smoking rooms are provided with open fireplaces and are lighted by large square windows, which are without sash to afford the maximum opening and are operated by a gear device on the inside. A passage on the starboard side affords access between the after rooms and the dining saloon, and also communicates with stairs to the pilot house. The extreme after end of the deck house is arranged as a veranda, enclosed except at the after end and reached from the living room through a vestibule on the starboard side, which also gives access to the guests' rooms below. The after deck, provided with the usual transom and awning, gives a clear deck space of over 22 feet. A pilot house and radio room are located on the boat deck, and forward of these is a fair-weather seating space.

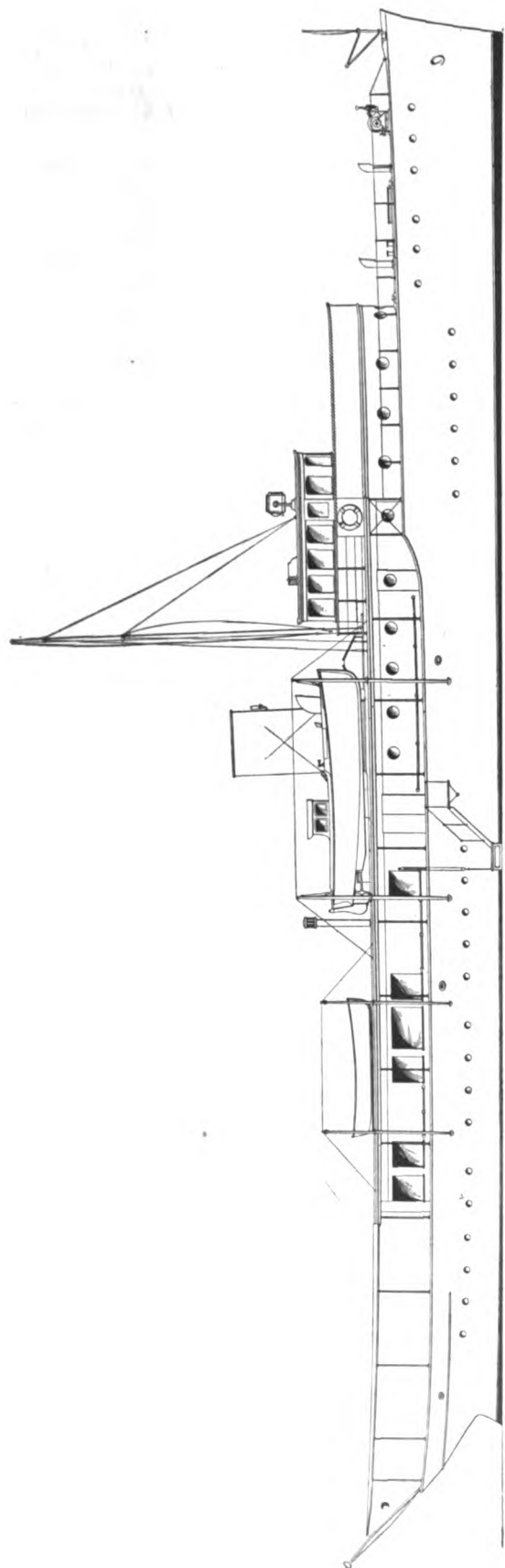
The quarters on the berth deck aft consist of two large staterooms for the owner with two wardrobes and a bath

room. Aft these on the port side are one double and one single stateroom with bath between and one smaller stateroom, while on the starboard side is a large stateroom with bath and a maid's room, toilet and linen locker. A toilet and shower room is located at the extreme after end of the passage. The entire berth deck forward of the engine room is utilized as crew space. Directly under the dining saloon is the officers' mess room, with dumbwaiter to pantry and stairs to the deck on the port side; also the refrigerator and galley storeroom and rooms for the captain, engineers, mate and steward. The forward portion of the berth deck, in way of the raised forecastle, is elevated 4 feet above the after portion, and on this deck are rooms for oilers, cook and second steward, a forecastle for six men, toilets and showers. An entry in the center gives access to the deck above and laundry below.

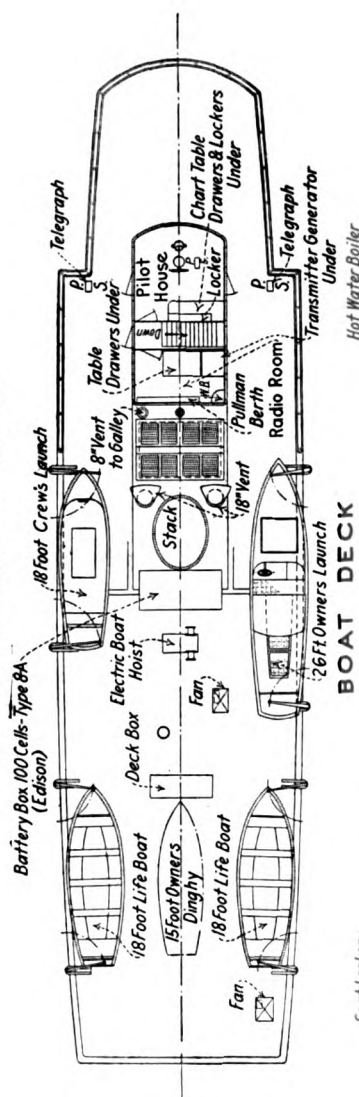
HULL

The hull is designed with full, graceful lines conducive to moderate speed, seaworthiness being an essential feature. The stem rakes forward with an inverse curve, sharp cut-water and full round at the forecastle deck. The stern is of the modified steamship type with the rudder entirely below the waterline. A bulwark rises in an easy curve abreast the pilot house to meet the raised forecastle deck at the forward end of the deck house.

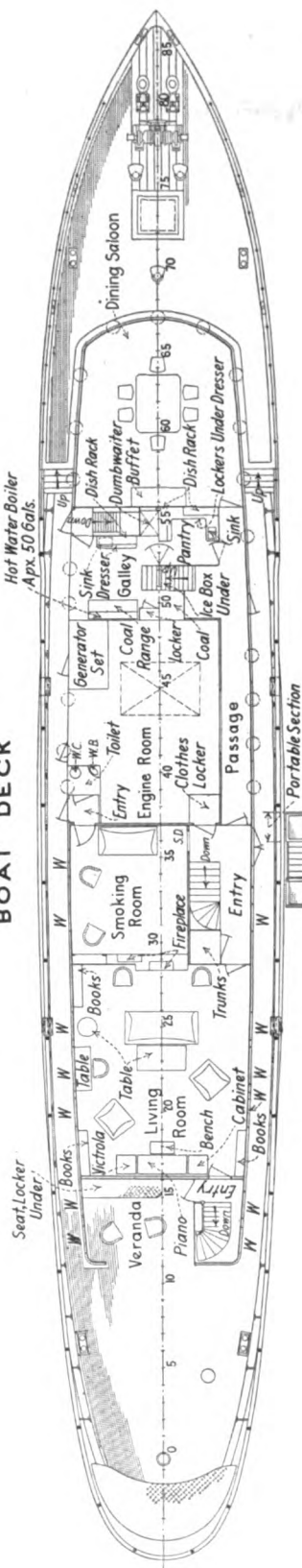
Somewhat heavier than is usual for a yacht of these dimensions, the shell plating ranges from $\frac{3}{8}$ -inch to $\frac{5}{16}$ -inch plate. The main deck, under wood, consists of $\frac{3}{8}$ -inch plate in way of the stringer and a 5-pound plate elsewhere. The floors are $\frac{3}{8}$ -inch and $\frac{5}{16}$ -inch plate, and the tank top $\frac{1}{4}$ -inch plate. The deck house is constructed of $\frac{1}{4}$ -inch and $\frac{3}{16}$ -inch plate. The frames and main deck beams are $4\frac{1}{2}$ -inch by 3-inch by 7.7-pound angles spaced 21 inches. Reverse frames of 3-inch by 3-inch by 5.1-pound angles are



OUTBOARD PROFILE



BOAT DECK



MAIN DECK

Fig. 1.—Outboard Profile and Weather Deck Plans of Astor Motor Yacht

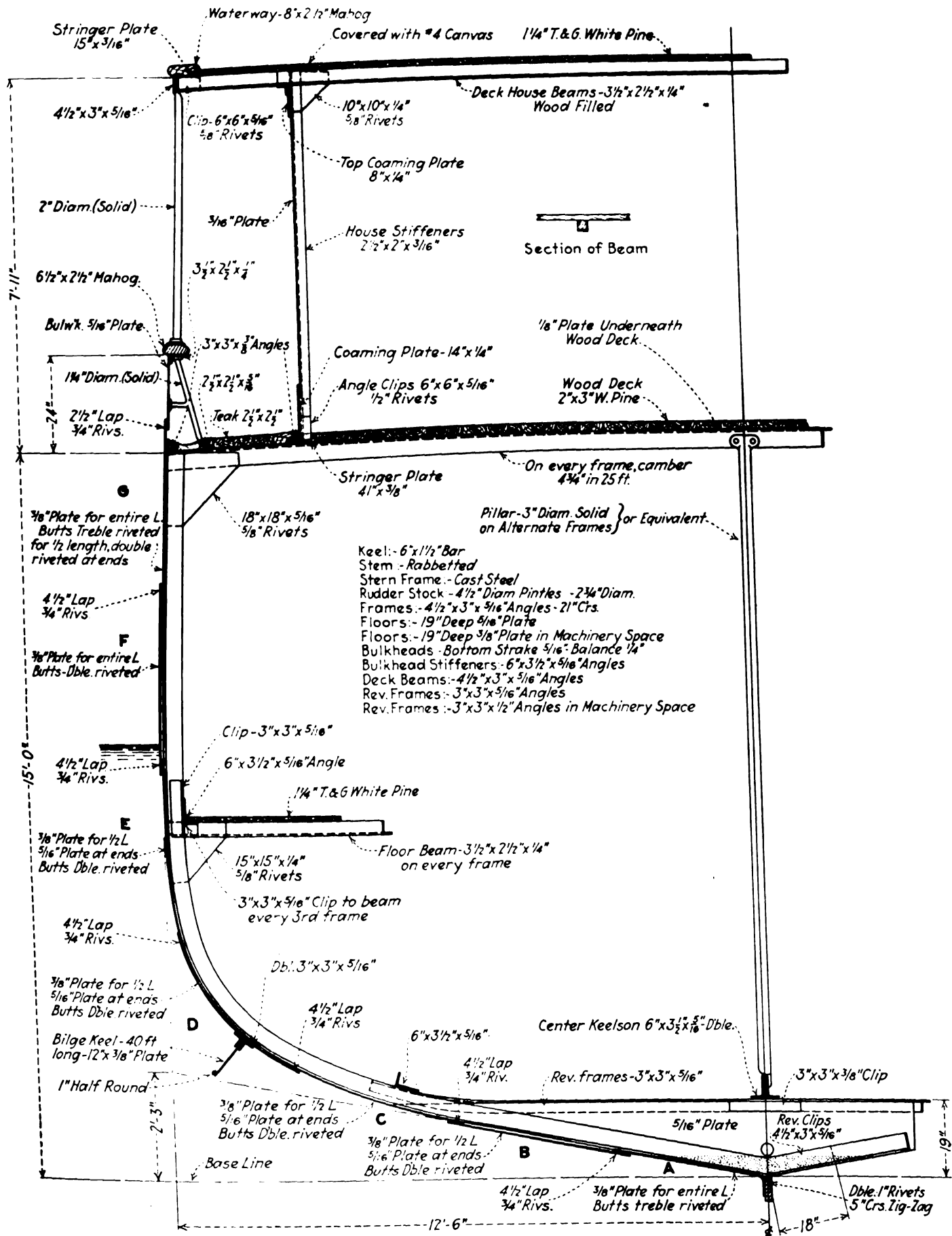
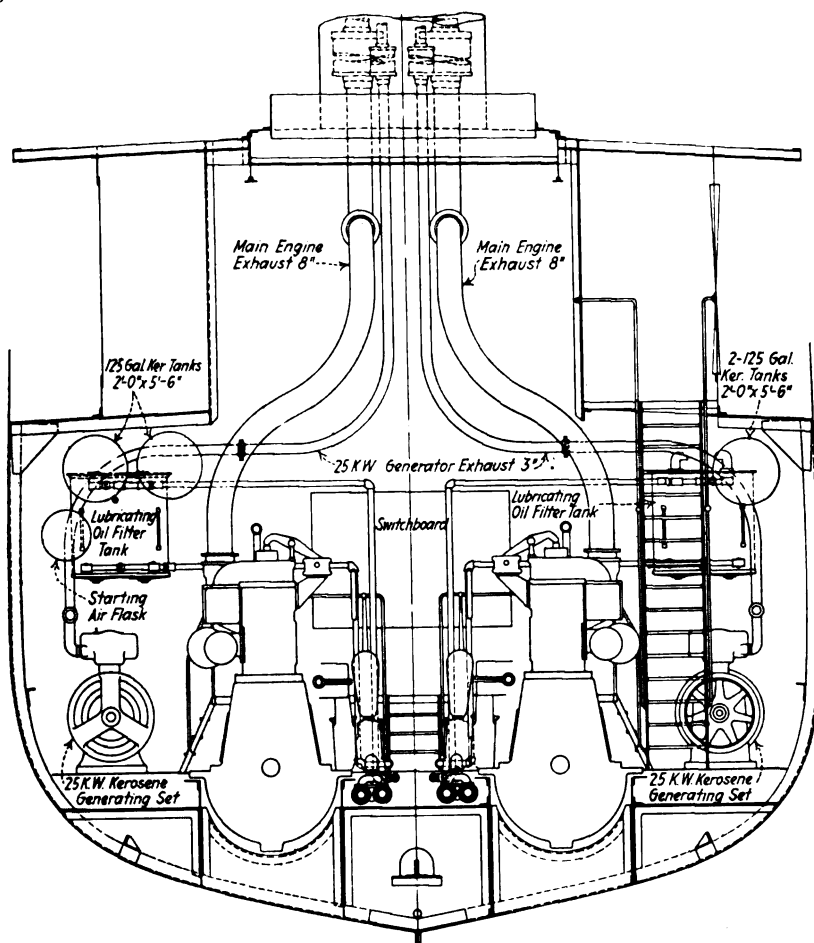
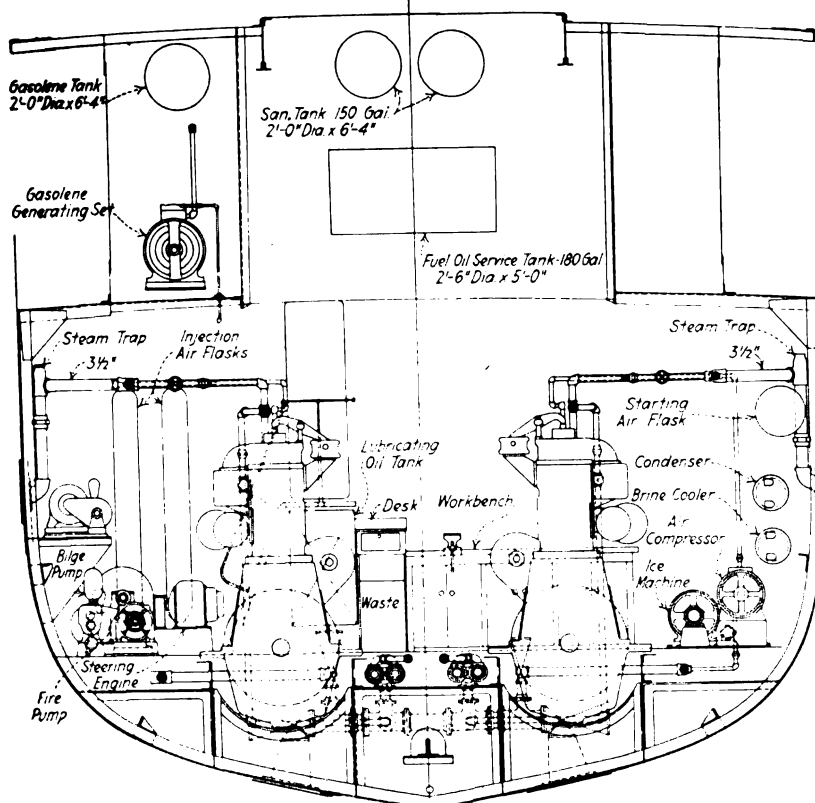


Fig. 3.—Midship Section 160-Foot Ocean-Going Motor Yacht



FRAME NO. 43
Looking Aft



FRAME NO. 47
Looking Ford

Fig. 4.—Sections Through Engine Room

fitted in way of the floors. Bilge stringers and center and side keelsons of 6-inch by $3\frac{1}{2}$ -inch by 9.8-pound angles are fitted and the house carlings are $3\frac{1}{2}$ -inch by $2\frac{1}{2}$ -inch by 4.9-pound angles.

There are seven full water and oiltight bulkheads of $\frac{5}{16}$ -inch and $\frac{1}{4}$ -inch plating with 3-inch by 3-inch by 7.2-pound bounding angles and 6-inch by $3\frac{1}{2}$ -inch by 9.8-pound angle stiffeners. These bulkheads are located at the forepeak, break of fore-castle deck, forward and after ends of engine room, after ends of oil tanks and water tank and the after peak.

The rudder is of the balanced type, built up of $\frac{1}{4}$ -inch steel plates on a forged frame with a 5-inch stock.

The main deck is planked with $2\frac{1}{2}$ -inch by $2\frac{1}{2}$ -inch teak and the boat deck with $1\frac{1}{2}$ -inch white pine, canvas covered abaft the pilot house.

MAIN PROPELLING MACHINERY AND AUXILIARIES

The two main engines, located amidships, are of the full Diesel type, each with six cylinders 12 15/16-inch bore and 18-inch stroke, direct drive, with horseshoe thrust, made by the Winton Engine Works, of Cleveland, Ohio. The manufacturers' test cards show 350 brake horsepower at 250 revolutions per minute for each engine.

In the engine room are also located two 25-kilowatt General Electric Company, type GM-12, generating sets, 110 volts, direct connected to 4 cycle 4 cylinder kerosene engines $7\frac{1}{4}$ inches by $7\frac{1}{2}$ inches with 560 revolutions per minute, in connection with which are 100 cells Edison A-8 batteries. This electrical equipment, together with a Winton $7\frac{1}{2}$ -kilowatt gasolene set installed in the upper engine room enclosure for emergency use, supply all the power for compressors, lighting, pumps and deck machinery.

Two Winton, model W-18, motor-driven air compressors for starting, whistle and charging air bottles used in conjunction with compressors, are attached to the main engines.

Pumps made by the Kinney Manufacturing Company are provided as follows.

Rilge pump—3-inch suction, $2\frac{1}{2}$ -inch discharge, 3-horsepower motor.

Fire pump— $2\frac{1}{2}$ -inch suction, 2-inch discharge, 3-horsepower motor.

Fresh water pump— $1\frac{1}{2}$ -inch suction, $1\frac{1}{2}$ -inch discharge, $\frac{3}{4}$ -horsepower motor.

Salt water pump— $1\frac{1}{2}$ -inch suction, $1\frac{1}{2}$ -inch discharge, $\frac{3}{4}$ -horsepower motor.

Oil service pump—1-inch suction, 1-inch discharge, $\frac{1}{2}$ -horsepower motor.

All pumps are bronze except the oil pumps.

An electrical steering gear, manufactured by the Mead-Morrison Manufacturing Company, is to be installed with control in the pilot house and the motor and gear in the engine room. An emergency tiller is also provided.

In the engine room are also installed all

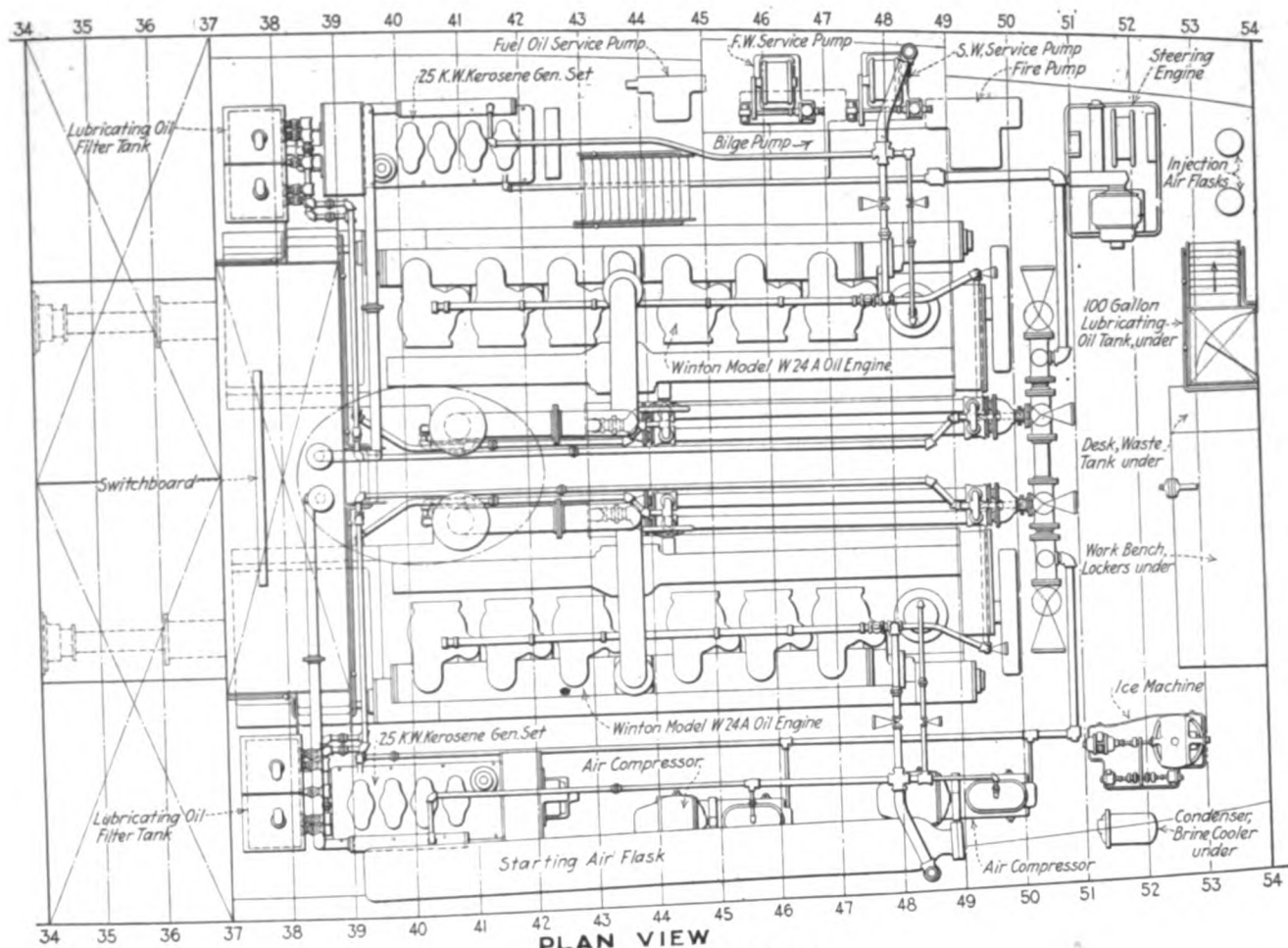


Fig. 5.—Plan of Engine Room

necessary air flasks, lubricating and kerosene oil tanks, switchboard, work bench and a one-ton ice machine supplied by the Clothel Manufacturing Company.

An electric windlass is mounted on the forecastle deck with its motor below the berth deck.

The small boats will be handled by an electric hoist on the boat deck abaft the stack.

The after quarters below deck are ventilated by two small motor-driven blowers located on the after boat deck with a supply duct system between partitions and under the floor.

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Oil fuel is carried in a deep tank aft and a low tank forward, each divided into two separate compartments and having a total capacity of 67 long tons.

A fresh water tank of 30 long tons capacity is located under the after quarters.

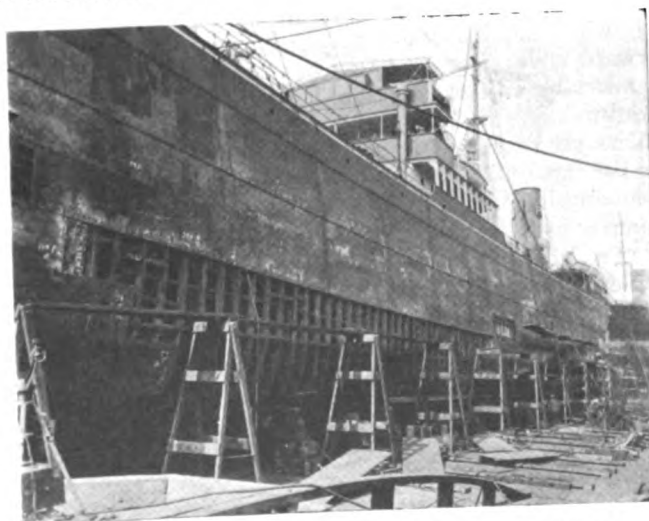
Iron Vessel Overhauled at Morse Dry Dock

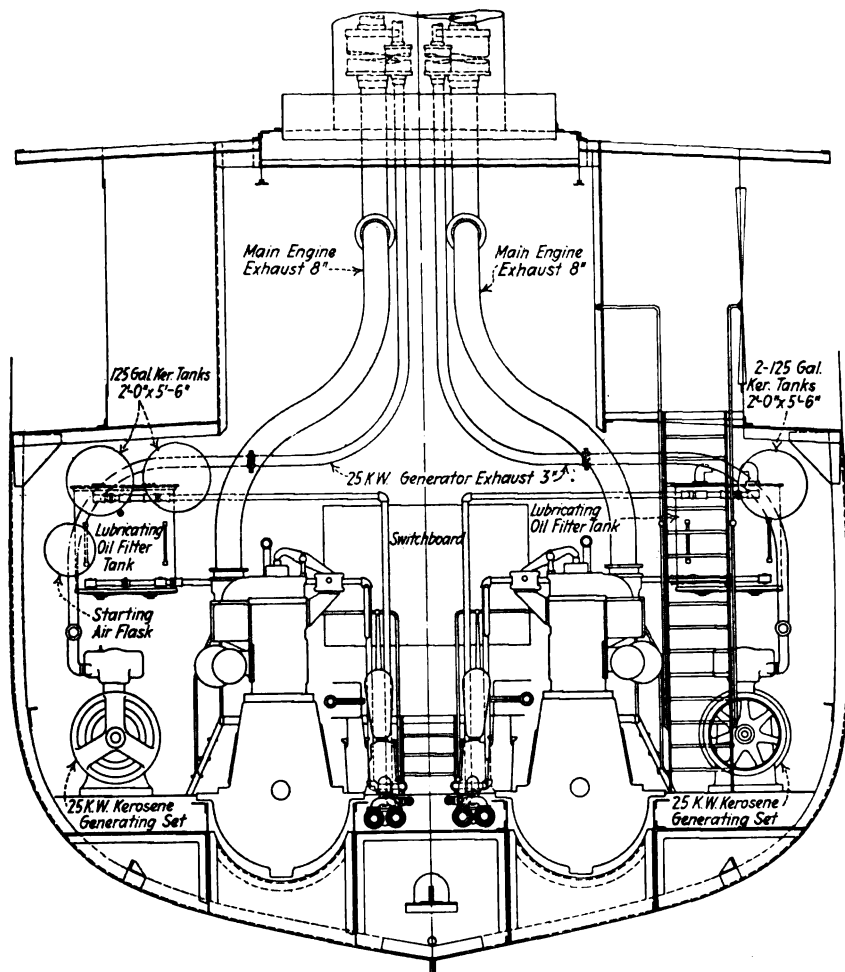
THE shipbuilding industry of today does not countenance the iron-plated ship, but such a craft has, despite the disadvantages in weight, etc., the properties of long life. An example of this type of vessel is found in the motorship *Tancarville*, which came to the Morse Dry Dock and Repair Company, Brooklyn, N. Y., for repairs recently.

While the ship had had its underbody tightened and re-

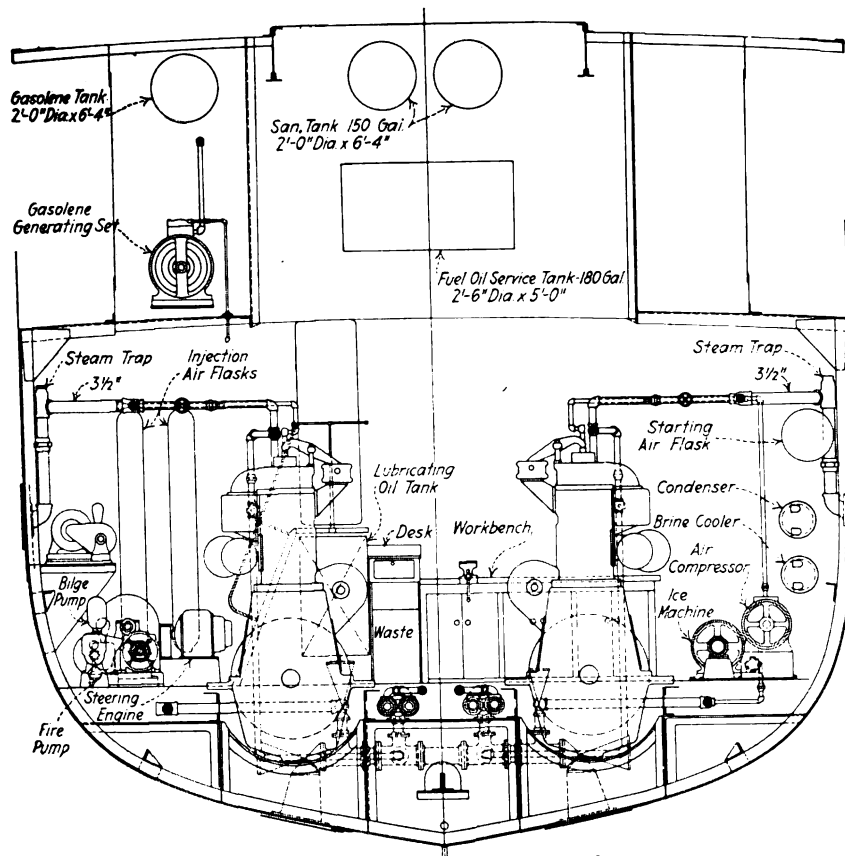
newed on previous occasions, it had not, in three decades, needed or received the thorough overhauling it underwent at the Morse plant. Its hull was completely reconditioned, new plates being put on where needed and other plates made watertight.

The *Tancarville's* history has been an interesting one. Originally a steamship, the vessel at one time was sunk off the coast of Siam by a boiler explosion. She was salvaged and completely fitted out in Hong Kong. Since her rehabilitation she has been converted into a motorship, being fitted with two motors of 500 horsepower each. These are said to be giving excellent service and an average speed of seven knots.

Removing Iron Plating of Motorship *Tancarville* at Morse Dry Dock



FRAME NO. 43
Looking Aft



FRAME NO. 47
Looking Ford

Fig. 4.—Sections Through Engine Room

fitted in way of the floors. Bilge stringers and center and side keelsons of 6-inch by 3 1/2-inch by 9.8-pound angles are fitted and the house carlings are 3 1/2-inch by 2 1/2-inch by 4.9-pound angles.

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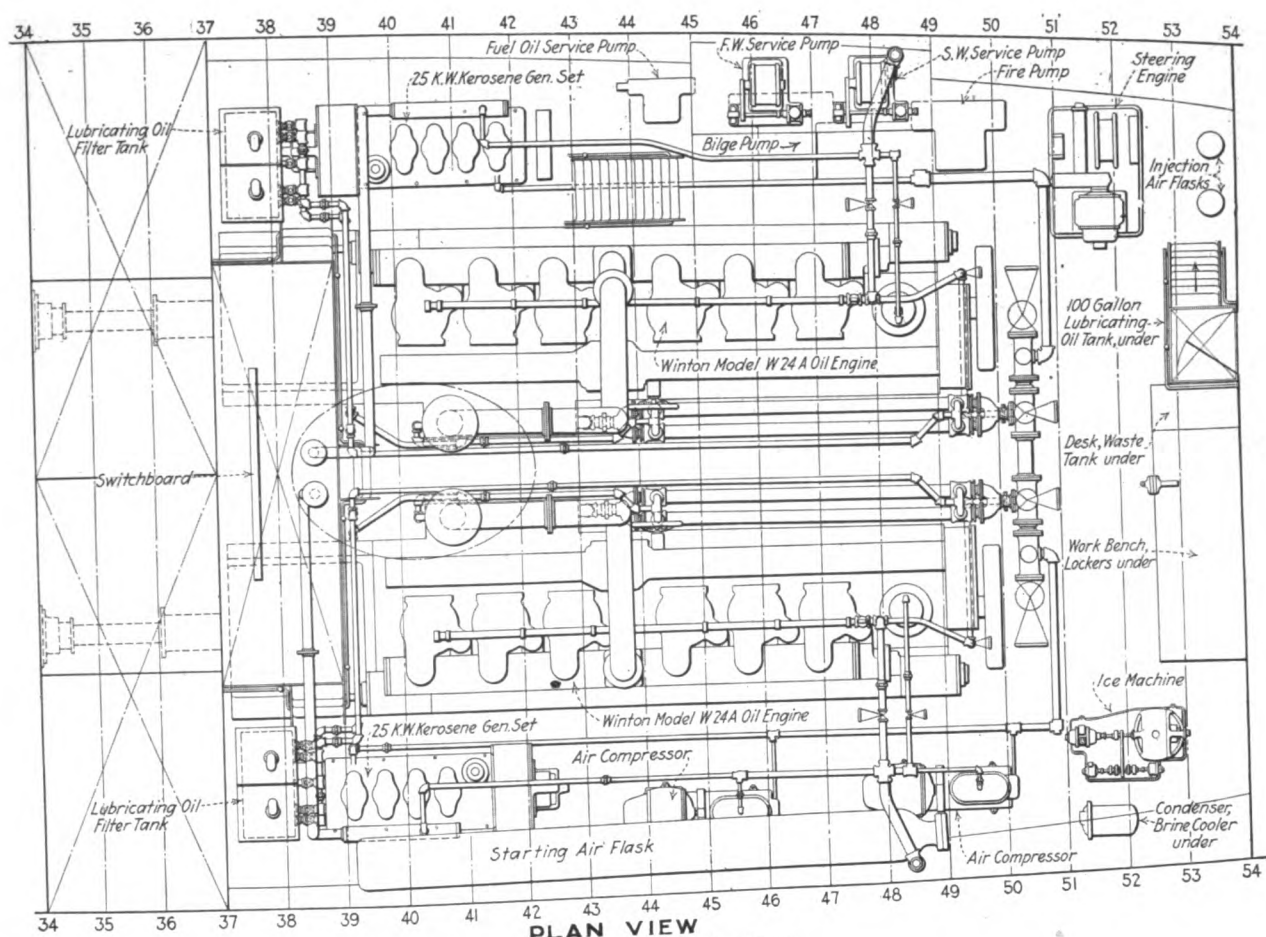


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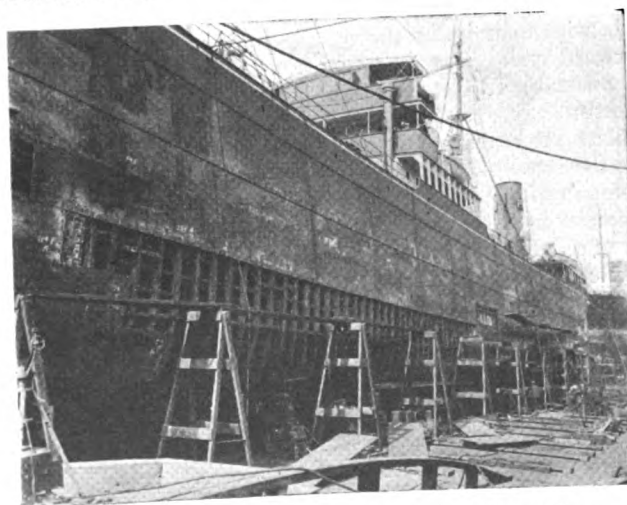
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Removing Iron Plating of Motorship *Tancarville* at Morse Dry Dock

New 20,000-Ton Tankers*

Standard Oil Tankers Designed and Built by the
Newport News Shipbuilding and Dry Dock Company

BY H. F. NORTON

THE vessels designed by the Newport News Shipbuilding and Dry Dock Company for the Standard Oil Company of New Jersey will be of interest on account of being, so far as we are aware, the largest tankers yet built and because of several unique features in design, especially in connection with the structural work.

They are two twin screw ships 550 feet between perpendiculars, 75 feet beam, 43 feet 3 inches depth to shelter deck and about 20,300 tons deadweight on a draft of 30 feet. The vessels are designed with straight stem and elliptical stern and rigged with three pole masts. They are of the shelter deck type with complete steel shelter and upper decks, except that the upper deck is omitted in the expansion trunk in way of the oil tanks. The vessels are being built under the special survey of the American Bureau of Shipping to the highest class.

PROPELLING MACHINERY

The propelling machinery is located in the stern and consists of two triple expansion engines set side by side in the same engine room. The engines are designed for 3,800 indicated horsepower total at 200 pounds working boiler pressure and a piston speed of 585 feet per minute. The cylinders are 23-inch, 39-inch and 68-inch diameter respectively with a 45-inch stroke. The high pressure and intermediate pressure valves are of the piston type and the low pressure valve is flat and double ported. The crank and thrust shafts are 13 inches in diameter, the line shafts 12½ inches and the propeller shafts 14½ inches.

One condenser is fitted outboard of each engine, with an attached air pump on each engine and attached bilge and sanitary pumps on the starboard engine only. The starting platform is at the level of the top of the engine bed plates and located between the two engines. There are two centrifugal circulating pumps with engines. The propellers are to turn outboard, one a left hand and one a right hand screw, each with cast iron hub and three manganese bronze blades.

BOILERS

There are three single-ended Scotch boilers placed side by side with their backs toward the engines and fired from the forward end. They are four furnace boilers 17 feet inside diameter by 12 feet long and designed for 200 pounds steam pressure. So far as we are aware, these are the largest Scotch boilers yet built in this country except those for three ships for the same owners built by the Harlan and Hollingsworth Company in 1916, each of which had two boilers 18 feet in diameter by 11 feet 7 inches long and which are said to have given excellent service. There is also cylindrical two furnace, single ended, return tube donkey boiler 10 feet 11 inches in diameter by 10 feet 10½ inches long. The main boilers are fitted for burning oil only and the donkey boiler for coal only.

FUEL SYSTEM

The fuel system consists of two horizontal duplex pumps 6 inches by 4 inches by 6 inches and two similar transfer pumps 14 inches by 9 inches by 12 inches. Three heaters are arranged so that oil may be discharged through them in

multiple. The service pumps and their fittings are located in a gas tight steel enclosure on the port side of the boiler room. The transfer pumps are located, one in the fireroom and one in a special steel pump room enclosure in the after end of the fore hold. The after pump has a 6-inch connection to the after fuel oil tank and a 6-inch discharge connection to the 6-inch fore and aft transfer line to the forward fuel oil tank and transfer pump and also a 6-inch discharge connection on the shelter deck. The forward pump has a 6-inch suction to the forward fuel oil tank and a 6-inch discharge to the transfer line and to the shelter deck.

AUXILIARIES

There are two main feed pumps 14 inches by 9 inches by 24 inches with brass water ends and automatic control gear, each to draw from the main feed tanks and reserve feed tanks and discharge through the feed heater or by-pass to the main and auxiliary checks on the main and donkey boilers. An auxiliary feed pump of the same size is fitted. There are also two injectors connected to the feed lines. There is an independent bilge pump, an engine room ballast pump, a forward ballast pump, an independent sanitary pump, a donkey boiler feed pump, a fresh water pump and an evaporator feed pump.

Besides the above auxiliaries there are two evaporators capable of producing 35 tons of fresh water each 24 hours and a distiller for 2,000 gallons a day.

ELECTRIC PLANT

The main electric plant consists of two 20-kilowatt generating sets in the engine room and there is also an emergency generating set of 12½ kilowatts capacity driven by a gasoline-kerosene engine located on the upper deck forward. This set is also connected to the radio set so as to provide for the lighting of the ship and sending of wireless messages even though the main engine room may be flooded or on fire.

REFRIGERATING PLANT

The refrigerating plant consists of a 2-ton ammonia machine fitted in a gas tight compartment in the engine room.

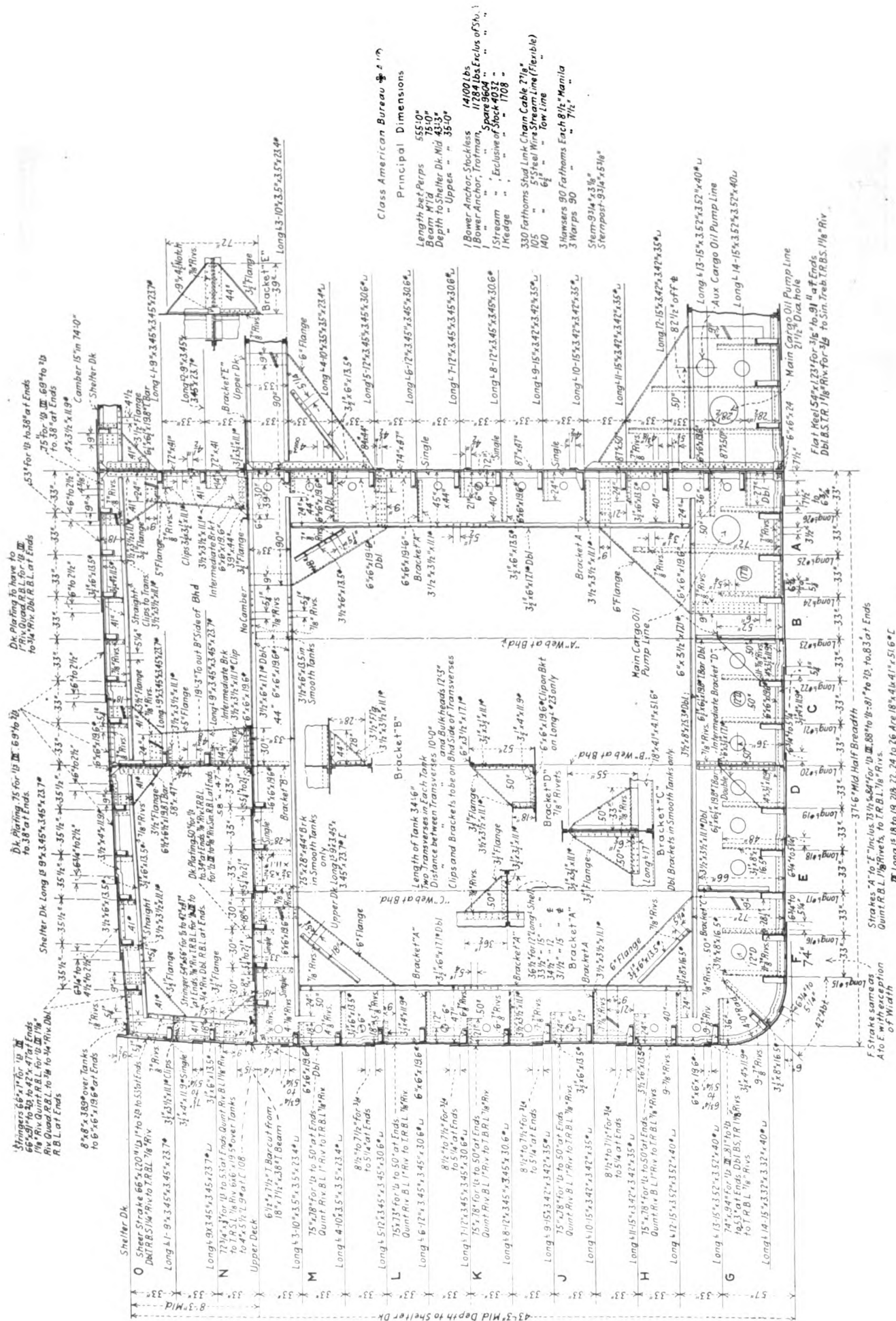
ENGINEERS' WORKSHOP

There is an engineers' workshop adjacent to the engine room equipped with a 14-inch screw cutting engine lathe about 6 feet between centers, a 20-inch drill press and a 12-inch double emery grinder, all driven from a countershaft connected with a 5-horsepower motor.

CARGO OIL PUMP ROOM

The cargo oil pump room is located amidships and fitted with four horizontal duplex main pumps with compound steam cylinders 12-inch and 18-inch diameters and 24-inch stroke and oil cylinders 14½-inch diameter. These pumps are arranged to work with the ship's steam at 180 pounds or shore steam at 70 pounds, having a by-pass connection admitting live steam to the low pressure cylinder when working with low pressure steam. There are also two auxiliary vertical duplex pumps 12 inches by 8 inches by 12 inches. The main cargo oil suction system consists of two lines of 14-inch

* Paper read before the Society of Naval Architects and Marine Engineers, New York, November 11, 1920.



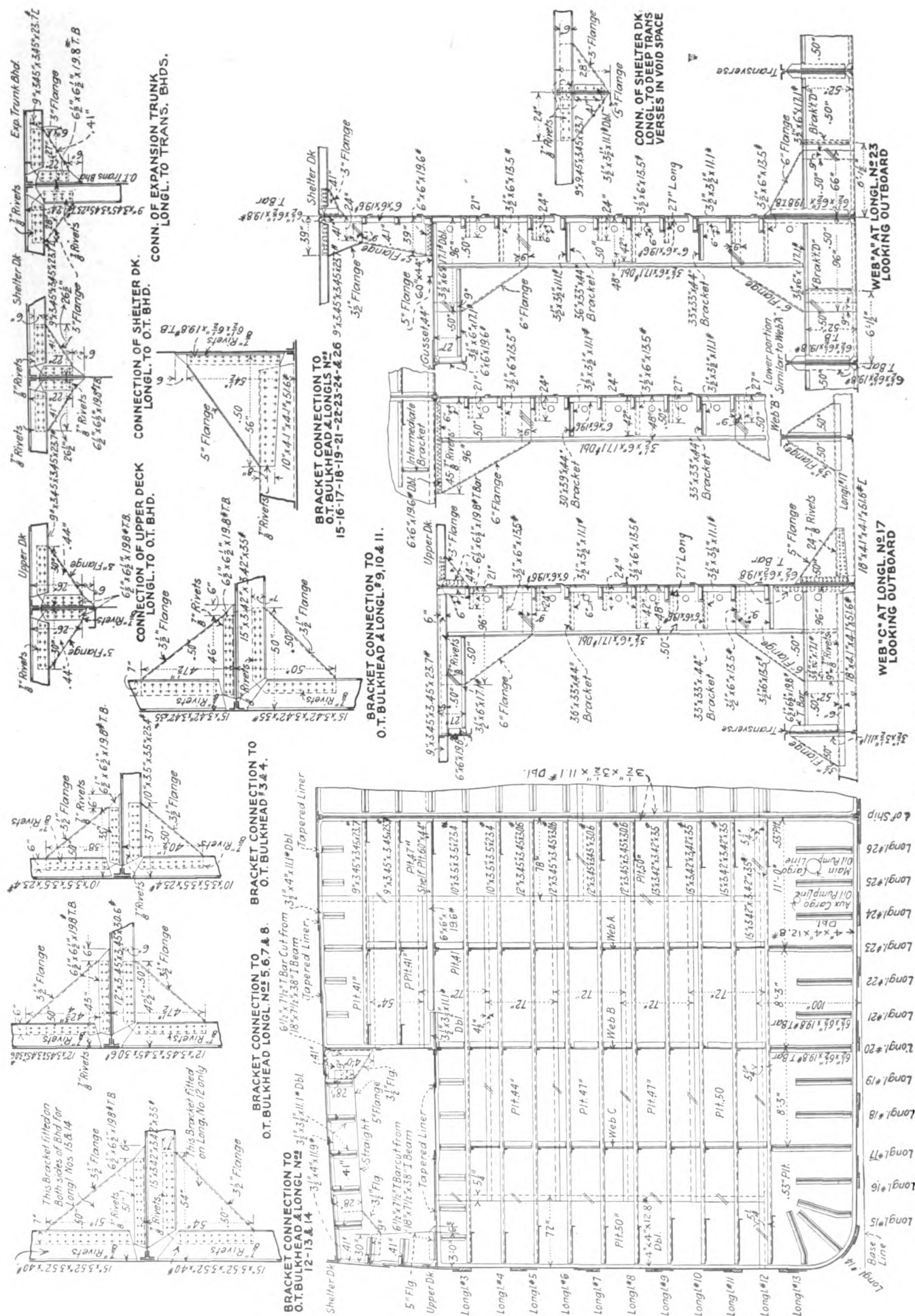


Fig. 3.—Details of Bulkhead Construction

pipes, one on each side of the centerline bulkhead for draining the after tanks and two similar lines leading forward for the forward tanks. Each main tank is connected to both main lines of piping by 10-inch valves and pipes. Cross connections are fitted in the pump room to enable any main pump to draw from any compartment on either side and discharge into any other compartment. There is also a 6-inch auxiliary suction line with a 4-inch suction branch fitted in each tank.

Most oil tankers are fitted with only two main cargo oil pumps. The above four large pumps are fitted on these vessels with the idea of being able to discharge the cargo with unusual rapidity. The 6-inch auxiliary suction line is fitted with the idea of being able to clean out the tanks after the large pumps have taken out the major portion of the oil. The size of the pumping equipment is evidence of the policy of the owners of obtaining the quickest possible turn around of the tankers in port.

There are four 12-inch discharge mains in the pump room connecting to a 12-inch main leading aft on the upper deck and to 12-inch cross mains on the shelter deck. There are also two 5-inch auxiliary discharges connecting to the by-pass of the main pumps. The discharge lines over the pump room are cross connected so that any of the pumps can discharge separately to either or both sides of the vessel. There are two 12-inch sea chests with stop valves fitted to the ship's sides in the pump room and connected to the pumps for ballasting the main cargo tanks.

STEAM HEATING SYSTEM

Complete steam heating system and heating coils for the main cargo tanks and fuel oil tanks are provided, and also steam smothering pipes for fire extinguishing.

HULL

It will be noticed from the plans that there are eight main cargo oil tanks each 34 feet 6 inches long and that the cargo oil pump room is also the same length. This length of cargo oil tank is unusually great, but it will be noticed that the oil tight centerline bulkhead divides each main tank into spaces on each side of the vessel which are approximately square; that is, the half beam of the ship which is 37 feet 6 inches is a little more than the length of a main cargo oil tank. There are no summer tanks and the wing spaces outboard of the expansion trunk and between the upper and shelter decks are used for pipe passages only. This is due to the fact that the vessel is designed primarily to carry one kind of oil and the omission of the summer tanks results in a simpler construction and a distribution of the structural material where it is more efficient in contributing to the longitudinal strength of the vessel.

GATEWOOD SYSTEM OF LONGITUDINAL FRAMING

The vessel is designed on the Gatewood system of longitudinal framing. The main framing consists of two deep transverse webs, ordinarily called transverses, fitted between each pair of main transverse bulkheads. The longitudinals are then worked continuously through these transverses and are cut and bracketed at the main transverse bulkheads. The Gatewood patented system of longitudinal framing takes advantage of the reinforcement of the longitudinals by the brackets at the bulkheads and so spaces the transverses and designs the brackets as to make the maximum bending moments in the longitudinals as small as possible. At the same time some of the reaction load is taken from the transverses and transferred to the more rigid transverse bulkheads. Although the distance between the main transverse bulkheads is 34 feet 6 inches, the transverses are spaced only 10 feet apart, thus making each transverse a distance of 12 feet 3 inches from the adjacent bulkhead. This dimension is 2

feet 3 inches greater than the distance between transverses, but results in no greater bending moments on the longitudinals than occur at the transverses on account of the brackets which are fitted at the bulkheads. The other scantlings of the vessel in general are arranged about as usual for a 10-foot spacing between transverses and bulkheads, on a longitudinally framed vessel of the usual type.

The ordinary bottom longitudinals are 18-inch by 4.1-inch by 51.6-pound channels spaced 33 inches, which is wider than on any previous longitudinally framed vessel so far as we are aware. The side longitudinals gradually decrease in size to a 10-inch by 3.5-inch by 23.4-pound channel for the first longitudinal under the upper deck. The brackets connecting these longitudinals to the main transverse bulkheads are shown on the type plan of oiltight transverse bulkheads and the way the brackets gradually decrease in size to suit the size of longitudinals will be noted. The connections of the brackets to oiltight bulkheads are all by means of 6½-inch by 6½-inch by 19.8 pound T-bars with the standing flange double riveted to the brackets to provide the strongest possible connection and facilitate calking.

BULKHEAD STIFFENERS

The stiffening of the bulkheads is interesting on account of the unusual expanse of bulkhead to be supported. Deep bottom longitudinals are worked in way of the vertical webs *A* and *B* on the bulkhead and web *A* is provided with a bracket and girder to the transverses at the level of the upper deck to take the bending moment at this point. The arrangement of these brackets and girders at the upper deck level to take the stresses transmitted from the webs of the transverse bulkheads is interesting, as will be noticed on the plans. There is a horizontal web at the upper deck level to take the reaction of the vertical web *A* at that point and from the upper deck to the shelter deck in line with web *A* there is a small web designed to carry the load transmitted from the horizontal stiffeners in this location on the bulkhead. Web *C* is provided with a girder at the top and bottom to connect it with the transverses and take care of the bending moments in the brackets at the ends of the web. These moments on web *B* are cared for by its connection to the deep longitudinal at the bottom and to the expansion trunk bulkhead at the top.

Special transverse webs are provided in the wing spaces above the upper deck to provide support for the side and deck longitudinals in this vicinity. In order to provide as much longitudinal strength as possible, the side and deck longitudinals in this vicinity are worked continuously through all of the transverses with butts staggered.

The rough and smooth sides of the bulkheads alternate port and starboard in the main cargo tanks and on the centerline bulkhead through the main tanks, so that all the bulkheads may be tested and the smooth sides examined, after the ship is in service, by filling the minimum number of tanks. Both transverse bulkheads of the pump room are arranged to be smooth on the inside of the pump room so as to be readily examined at all times. In the same way all of the stiffening is kept inside of the fuel oil tanks at the ends, which will normally have oil in them.

ARRANGEMENT OF SHELL PLATING

The sheer line of the vessel is straight and parallel to the base line for nearly the whole extent of the main cargo tanks. This fact, and the fact that the pump room is the same length as the main cargo tanks, permit a rather unique arrangement of the shell plating amidships. Each midship shell plate from the keel to the stringer is the same length between centers of butts, namely, 34 feet 6 inches, the length of the main cargo tanks. All the butts are arranged symmetrically with reference to the transverse bulkheads and the transverses, so that a number of plates amidships on each strake are exactly

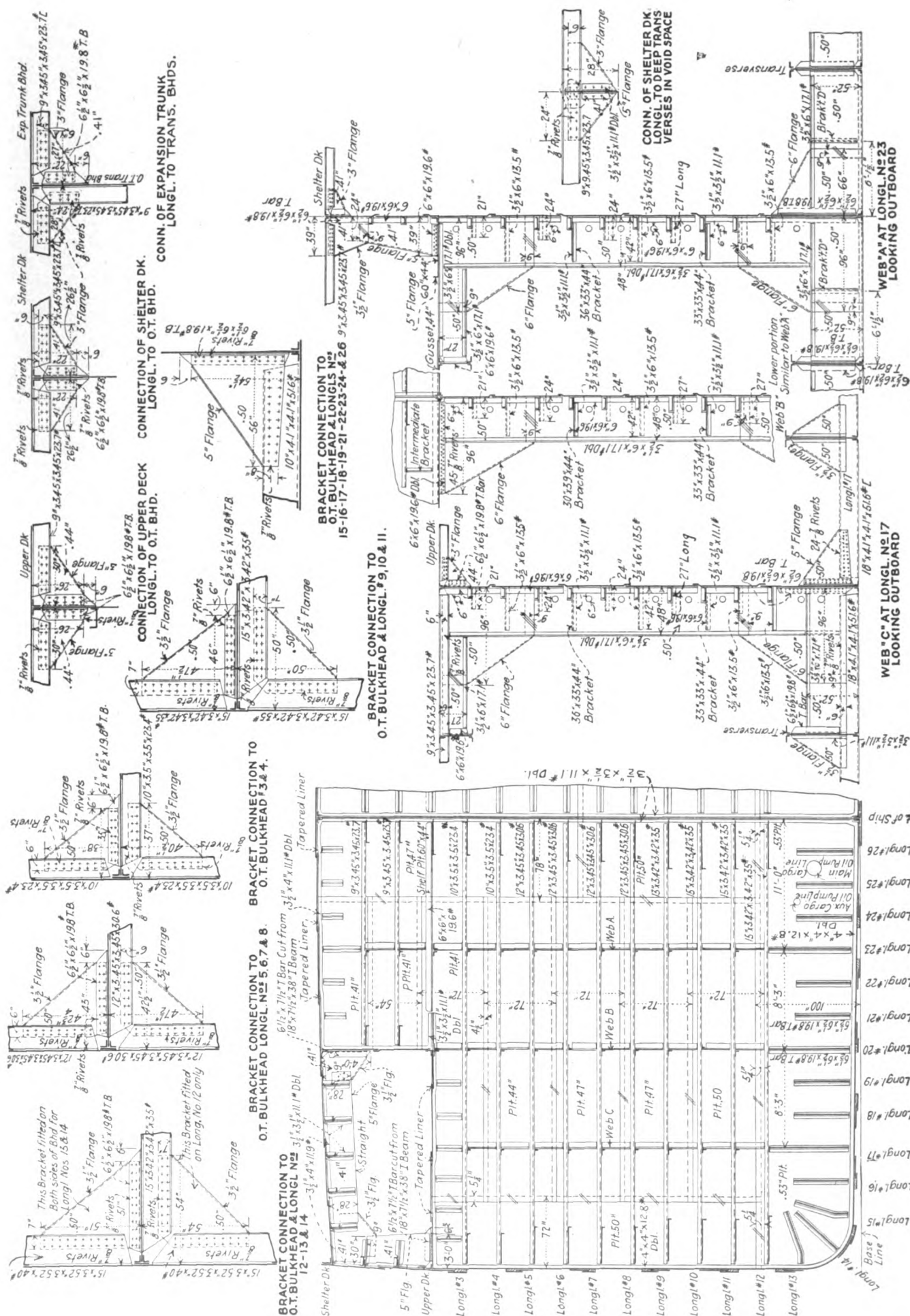


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like each other in every respect. An exception to the above is that the plates of the bilge strakes *F* and *G* are made shorter for convenience in rolling for the turn of the bilge, but even these are symmetrically arranged so as to be like each other in sets of three.

Another point of interest is that, instead of arranging the clips on the transverses symmetrical with the midship section of the vessel as is usually done, they are arranged symmetrical with the adjacent transverse bulkheads in each case.

The straight sheer and the fact that the pump room is the same length as a main cargo tank result in a particularly symmetrical arrangement of the centerline bulkhead plating and also of the deck plating. Another interesting point on the deck plan is the small size of the hatches and the small number of them on account of the omission of the summer tanks.

FUEL TANKS

The main fuel oil tank is fitted at the after end of the main cargo oil tanks and a cofferdam worked between it and the boiler room. There is also a fuel oil tank fitted at the forward end of the main cargo oil tanks. The space between the forward fuel oil tank and the fore peak bulkhead is arranged as a hold space divided into two compartments by a watertight bulkhead to the upper deck level. There is a double bottom fitted under this space arranged to be used for water ballast. A double bottom for feed water is also fitted under the engine and boiler spaces. The forward peak tank is arranged for water ballast. The after peak tank is arranged for fresh water.

Accommodations for the captain, deck officers, etc., are

provided in a double tier of steel deck houses amidship above the bridge deck. A wheel and chart house of teak is built on top of the upper house and a navigating bridge fitted at this level. Quarters for the engineers and those for the petty officers are located on the upper deck abreast the engine casing. The seamen and firemen have ample and commodious quarters in the after end of the upper deck, including the rather unusual feature of a separate pantry adjacent to the mess rooms.

A steel house is provided for the steering gear on the shelter deck aft and the top of this house fitted as a docking bridge.

Four 26-foot metallic lifeboats are provided, all under mechanical davits.

The vessels also have ample electric lighting arrangements, cold storage rooms, steam heating system, interior communication system, drainage system, fire main and deck service system, steam steering gear, steam windlass and winches. The plumbing arrangements are unusually complete for this type of vessel.

In fact, the size, outfitting and equipment of these vessels are such as to make them a notable addition to the already very notable fleet which has been built up under the supervision of D. T. Warden, manager of the foreign shipping department of the owners, the Standard Oil Company of New Jersey, and R. W. Morrell, their naval architect, who considers that these tankers, on account of their size and the simplified design made possible by adapting them to one trade only, will prove to be the most economical oil carriers yet produced.

Diesel-Electric Drive for Double Ended Ferry Boats and Low Powered Cargo Vessels

BY COMMANDER S. M. ROBINSON, U. S. N.*

THERE is a growing tendency to widen the field of the Diesel engine, but its lack of good maneuvering qualities has somewhat handicapped it in the marine field. It has been proposed to obviate this difficulty by the use of electricity. The objection to this method is that it apparently entails a loss of 13 percent in efficiency due to transmission losses. In the following article it is proposed to show that for double ended ferry boats and low powered cargo steamers this loss is entirely fictitious and that instead of a loss there is an actual small gain in efficiency due to the use of electricity for propulsion.

DOUBLE ENDED FERRY BOATS

In the July, 1920, issue of MARINE ENGINEERING there was an article entitled "Ferry Boat with Diesel Electric Drive" written by Mr. Renwick C. Dickie. In this article he mentioned the possibility of improvement in propulsion due to the possibility of operating the forward and after screws at different speeds.

With this type of boat there are four methods of propulsion that may be used:

(1) The two screws may be run at the same speed. This is the ordinary method where both screws are operated by one engine.

(2) The two screws may be run at slightly different speeds, so that each one will deliver the same effective horsepower.

(3) The forward screw can be allowed to run idle and, in this case, will act as a drag on the ship, all the power being delivered to the after screw.

(4) The after screw can be designed to deliver all the power needed to propel the ship, the forward screw being kept turning over at a speed just great enough to keep it from acting as a drag on the ship.

In regard to the third method of propulsion, it is believed that there would be very little, if any, gain over methods (1) and (2) on account of the very large increase in effective horsepower required for propulsion, due to the dragging screw. Experiments on the *Jupiter* and *New Mexico* indicate that this may be as high as 35 percent in the case of the ferry boat in question. This amount will vary considerably with the speed, and in some cases it is as low as 15 percent. In any case, however, this method cannot be as efficient as the fourth method, since in the fourth method the loss due to the forward screw is only about 4.5 percent, as will be seen later on. This, then, narrows us down to a comparison of methods (1), (2) and (4).

ANALYSIS OF SIMILAR FERRY BOAT

Before proceeding to a comparison of these three methods of propulsion for this ferry boat there is given an analysis of a similar double ended ferry boat in which the effective horsepower required to tow the hull had been determined by a model tank experiment. The actual horsepower and revolutions necessary to drive the ship at the given speed were then measured on actual trial, and from these data it is possible to determine the additional effective horsepower required due to the propeller race of the forward screw striking against the forward end of the boat.

These data have been analyzed, using the Dyson method

* Fleet engineer, Pacific Fleet, United States Navy.

TABLE 1.—FERRY BOAT HULL DATA

$LWL = 210 \text{ feet. } B = 45.1 \text{ feet. } H = 13 \text{ feet. } \frac{B}{LWL} = .215.$	
$N.B.C. = .578.$	
$\frac{PA}{DA_1} = .432$	$\frac{PA}{DA_1} = .432$
$\frac{PA}{DA} = .324$	$\frac{PA}{DA} = .324$
$P = 9.55 \text{ feet}$	$P = 9.55 \text{ feet}$
$D = 10.5 \text{ feet}$	$D = 10.5 \text{ feet}$
$SBC = .76$	$SBC = 0$
$K = 1.36$	$K = 1$
$V = 19 = \frac{TS \times P \times (1-s)}{\pi D \times 101.33}$	$V = 16.14 = \frac{TS \times P \times (1-s)}{\pi D \times 101.33}$
$v = 12.73$	$v = 12.73$
$R_4 = 147.9 \text{ (actual trial)}$	$R_4 = 147.9 \text{ (actual trial)}$
$1-s = .9135 = \frac{v \times 101.33}{P \times R_4}$	$1-s = .9135 = \frac{v \times 101.33}{P \times R_4}$
$s = .0865$	$s = .0865$
$IHP = 3,830 = \frac{TS \times P \times IT_D \times D}{\pi \times 291.8}$	$IHP = 3,830 = \frac{TS \times P \times IT_D \times D}{\pi \times 291.8}$
$PC = .599$	$PC = .599$
$EHP = 2,293$	$EHP = 2,293$
$\frac{v}{V} = .67$	$\frac{v}{V} = .789$
$S = .069.$	$S = .21$
$v^r = 1,380 \text{ (taken from Y Sheet 21)}$	$v^r = 2,043 \text{ (taken from X Sheet 21)}$
$V^r = 6,500 \text{ (taken from X Sheet 21)}$	$V^r = 4,093 \text{ (taken from X Sheet 21)}$
$\text{(After) } IHP_4 = \frac{.0865 \times 3,830 \times 1,380}{.069 \times 6,500} = 1,020$	$\text{(Forward) } IHP_4 = \frac{.0865 \times 3,830 \times 2,043}{.21 \times 4,093} = 787$
$\text{(After) } IHP_p = \frac{1,020}{1.36} = 750$	$\text{(Forward) } IHP_p = \frac{787}{M_R} = \frac{787}{1.05} = 750$
$10^8 = \frac{3,830}{750} = 5.105$	$10^8 = 5.105$
$\frac{ehp}{EHP} = .209$	$\frac{ehp}{EHP} = .209$
$ehp = 479$	$ehp = 479$
$\text{(After) } PC = \frac{479}{1,020} = .47$	$\text{(Forward) } PC \text{ (apparent)} = \frac{479}{787} = .609$
	$\text{(Forward) } PC \text{ (actual)} = \frac{479 - 258}{787} = .281$

TABLE 1.—FERRY BOAT (Continued)

of analysis, and the result is given in Table 1. It will be noted that the calculated indicated horsepower is 1,807, while that actually measured on the trial was 1,845, or a difference of about 2 percent, which checks the correctness of the method. From these data it will be seen that the increase of effective horsepower due to the propeller race of the forward screw is 258, or 37 percent of the effective horsepower due to the hull resistance. This increase of effective horsepower will vary with the type of hull used, but as the two vessels under consideration are both double ended ferry boats it may be assumed that the percentage of increase will be about the same for both.

TABLE 2.—ELECTRIC DRIVEN FERRY BOAT

D	10	10	10
$\left. \begin{array}{l} ehp \\ EHP \end{array} \right\}$	.2	.3	.4
ehp	340	340	340
$EHP = ehp \div \frac{ehp}{EHP}$ }	1,700	1,133	850
v	10	10	10
$\left. \begin{array}{l} v \\ V \end{array} \right\}$	.57	.64	.69
$V = v \div \frac{v}{V}$ }	17.54	15.62	14.5
C	2.88	2.88	2.88
D^3	100	100	100
$\left. \begin{array}{l} PA \\ DA \end{array} \right\} \times ET_P = \frac{EHP \times C}{D^3 \times V}$ }	2.79	2.09	1.687
SBC	.7	.7	.7
$\left. \begin{array}{l} PA \\ DA \end{array} \right\}$	.31	.248	.22
PC	.677	.704	.708
$IHP = \frac{EHP}{PC}$ }	2,510	1,610	1,200
10^3	5.344	3.504	2.597
$IHP_p = IHP \div 10^3$	470	460	462
K	1.225	1.225	1.225
$IHP_a = IHP_p \times K$	576	564	566
V_1	19.746	15.852	13.787
$P = (D \times V) \div V_1$	8.89	9.85	10.5
S	.081	.077	.076
V^3	4,365	3,310	2,400
v^3	871	871	871
$s = \frac{S \times IHP_a \times V^3}{IHP \times v^3}$ }	.0932	.103	.099
$1 - s$	.9068	.897	.901
$R_d = \frac{v \times 101.33}{P(1 - s)}$ }	120.5	114.7	107.2

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C	2.88	2.88	2.88
D^3	100	100	100
$\frac{PA}{DA} \times ET_P = \frac{EHP \times C}{D^3 \times V}$ }	2.79	2.09	1.687
SBC	.7	.7	.7
$\frac{PA}{DA}$ }	.31	.248	.22
PC	.677	.704	.708
$IHP = \frac{EHP}{PC}$ }	2,510	1,610	1,200
10^3	5.344	3.504	2.597
$IHP_p = IHP \div 10^3$	470	460	462
K	1.225	1.225	1.225
$IHP_d = IHP_p \times K$	576	564	566
V_1	19.746	15.852	13.787
$P = (D \times V) \div V_1$	8.89	9.85	10.5
S	.081	.077	.076
V^v	4.365	3.310	2.400
v^v	871	871	871
$s = \frac{S \times IHP_d \times V^v}{IHP \times v^v}$ }	.0932	.103	.099
$1 - s$	.9068	.897	.901
$R_d = \frac{v \times 101.33}{P(1 - s)}$ }	120.5	114.7	107.2

like each other in every respect. An exception to the above is that the plates of the bilge strakes *F* and *G* are made shorter for convenience in rolling for the turn of the bilge, but even these are symmetrically arranged so as to be like each other in sets of three.

Another point of interest is that, instead of arranging the clips on the transverses symmetrical with the midship section of the vessel as is usually done, they are arranged symmetrical with the adjacent transverse bulkheads in each case.

The straight sheer and the fact that the pump room is the same length as a main cargo tank result in a particularly symmetrical arrangement of the centerline bulkhead plating and also of the deck plating. Another interesting point on the deck plan is the small size of the hatches and the small number of them on account of the omission of the summer tanks.

FUEL TANKS

The main fuel oil tank is fitted at the after end of the main cargo oil tanks and a cofferdam worked between it and the boiler room. There is also a fuel oil tank fitted at the forward end of the main cargo oil tanks. The space between the forward fuel oil tank and the fore peak bulkhead is arranged as a hold space divided into two compartments by a watertight bulkhead to the upper deck level. There is a double bottom fitted under this space arranged to be used for water ballast. A double bottom for feed water is also fitted under the engine and boiler spaces. The forward peak tank is arranged for water ballast. The after peak tank is arranged for fresh water.

Accommodations for the captain, deck officers, etc., are

provided in a double tier of steel deck houses amidship above the bridge deck. A wheel and chart house of teak is built on top of the upper house and a navigating bridge fitted at this level. Quarters for the engineers and those for the petty officers are located on the upper deck abreast the engine casing. The seamen and firemen have ample and commodious quarters in the after end of the upper deck, including the rather unusual feature of a separate pantry adjacent to the mess rooms.

A steel house is provided for the steering gear on the shelter deck aft and the top of this house fitted as a docking bridge.

Four 26-foot metallic lifeboats are provided, all under mechanical davits.

The vessels also have ample electric lighting arrangements, cold storage rooms, steam heating system, interior communication system, drainage system, fire main and deck service system, steam steering gear, steam windlass and winches. The plumbing arrangements are unusually complete for this type of vessel.

In fact, the size, outfitting and equipment of these vessels are such as to make them a notable addition to the already very notable fleet which has been built up under the supervision of D. T. Warden, manager of the foreign shipping department of the owners, the Standard Oil Company of New Jersey, and R. W. Morrell, their naval architect, who considers that these tankers, on account of their size and the simplified design made possible by adapting them to one trade only, will prove to be the most economical oil carriers yet produced.

Diesel-Electric Drive for Double Ended Ferry Boats and Low Powered Cargo Vessels

BY COMMANDER S. M. ROBINSON, U. S. N.*

THERE is a growing tendency to widen the field of the Diesel engine, but its lack of good maneuvering qualities has somewhat handicapped it in the marine field. It has been proposed to obviate this difficulty by the use of electricity. The objection to this method is that it apparently entails a loss of 13 percent in efficiency due to transmission losses. In the following article it is proposed to show that for double ended ferry boats and low powered cargo steamers this loss is entirely fictitious and that instead of a loss there is an actual small gain in efficiency due to the use of electricity for propulsion.

DOUBLE ENDED FERRY BOATS

In the July, 1920, issue of MARINE ENGINEERING there was an article entitled "Ferry Boat with Diesel Electric Drive" written by Mr. Renwick C. Dickie. In this article he mentioned the possibility of improvement in propulsion due to the possibility of operating the forward and after screws at different speeds.

With this type of boat there are four methods of propulsion that may be used:

(1) The two screws may be run at the same speed. This is the ordinary method where both screws are operated by one engine.

(2) The two screws may be run at slightly different speeds, so that each one will deliver the same effective horsepower.

(3) The forward screw can be allowed to run idle and, in this case, will act as a drag on the ship, all the power being delivered to the after screw.

(4) The after screw can be designed to deliver all the power needed to propel the ship, the forward screw being kept turning over at a speed just great enough to keep it from acting as a drag on the ship.

In regard to the third method of propulsion, it is believed that there would be very little, if any, gain over methods (1) and (2) on account of the very large increase in effective horsepower required for propulsion, due to the dragging screw. Experiments on the *Jupiter* and *New Mexico* indicate that this may be as high as 35 percent in the case of the ferry boat in question. This amount will vary considerably with the speed, and in some cases it is as low as 15 percent. In any case, however, this method cannot be as efficient as the fourth method, since in the fourth method the loss due to the forward screw is only about 4.5 percent, as will be seen later on. This, then, narrows us down to a comparison of methods (1), (2) and (4).

ANALYSIS OF SIMILAR FERRY BOAT

Before proceeding to a comparison of these three methods of propulsion for this ferry boat there is given an analysis of a similar double ended ferry boat in which the effective horsepower required to tow the hull had been determined by a model tank experiment. The actual horsepower and revolutions necessary to drive the ship at the given speed were then measured on actual trial, and from these data it is possible to determine the additional effective horsepower required due to the propeller race of the forward screw striking against the forward end of the boat.

These data have been analyzed, using the Dyson method

* Fleet engineer, Pacific Fleet, United States Navy.

TABLE 1.—FERRY BOAT HULL DATA

LWL = 210 feet. B = 45.1 feet. H = 13 feet. $\frac{B}{LWL} = .215$.
N.B.C. = .578.

After Screw	Forward Screw
$\frac{PA}{DA} = .432$	$\frac{PA}{DA} = .432$
$\frac{PA}{DA} = .324$	$\frac{PA}{DA} = .324$
P = 9.55 feet	P = 9.55 feet
D = 10.5 feet	D = 10.5 feet
SBC = .76	SBC = 0
K = 1.36	K = 1
$V = 19 = \frac{TS \times P \times (1-s)}{\pi D \times 101.33}$	$V = 16.14 = \frac{TS \times P \times (1-s)}{\pi D \times 101.33}$
v = 12.73	v = 12.73
Ra = 147.9 (actual trial)	Ra = 147.9 (actual trial)
$1-s = .9135 = \frac{v \times 101.33}{P \times Ra}$	$1-s = .9135 = \frac{v \times 101.33}{P \times Ra}$
s = .0865	s = .0865
$IHP = 3,830 = \frac{TS \times P \times IT_D \times D}{\pi \times 291.8}$	$IHP = 3,830 = \frac{TS \times P \times IT_D \times D}{\pi \times 291.8}$
PC = .599	PC = .599
EHP = 2,293	EHP = 2,293
$\frac{v}{V} = .67$	$\frac{v}{V} = .789$
S = .069	S = .21
v ^r = 1,380 (taken from Y Sheet 21)	v ^r = 2,043 (taken from X Sheet 21)
V ^r = 6,500 (taken from X Sheet 21)	V ^r = 4,093 (taken from X Sheet 21)
(After) IHP _a = $\frac{.0865 \times 3,830 \times 1,380}{.069 \times 6,500} = 1,020$	(Forward) IHP _a = $\frac{.0865 \times 3,830 \times 2,043}{.21 \times 4,093} = 787$
(After) IHP _p = $\frac{1,020}{1.36} = 750$	(Forward) IHP _p = $\frac{787}{M_R} = \frac{787}{1.05} = 750$
$10^s = \frac{3,830}{750} = 5.105$	$10^s = 5.105$
$\frac{ehp}{EHP} = .209$	$\frac{ehp}{EHP} = .209$
ehp = 479	ehp = 479
(After) PC = $\frac{479}{1,020} = .47$	(Forward) PC (apparent) = $\frac{479}{787} = .609$
	(Forward) PC (actual) = $\frac{479 - 258}{787} = .281$

TABLE 1.—FERRY BOAT (Continued)

IHP_a (total) = 1,020 + 787 = 1,807.
IHP_a (actual) = 1,845.
Difference = 38 = about 2 percent.
ehp (total) = 479 + 479 = 958.
ehp (due to ship resistance) = 700.
Difference = ehp due to propeller race from forward screw = 258, or 37 percent of the ship's resistance.

of analysis, and the result is given in Table 1. It will be noted that the calculated indicated horsepower is 1,807, while that actually measured on the trial was 1,845, or a difference of about 2 percent, which checks the correctness of the method. From these data it will be seen that the increase of effective horsepower due to the propeller race of the forward screw is 258, or 37 percent of the effective horsepower due to the hull resistance. This increase of effective horsepower will vary with the type of hull used, but as the two vessels under consideration are both double ended ferry boats it may be assumed that the percentage of increase will be about the same for both.

TABLE 2.—ELECTRIC DRIVEN FERRY BOAT

D	10	10	10
$\frac{ehp}{EHP}$	.2	.3	.4
ehp	340	340	340
$EHP = ehp \div \frac{ehp}{EHP}$	1,700	1,133	850
v	10	10	10
$\frac{v}{V}$	.57	.64	.69
$V = v \div \frac{v}{V}$	17.54	15.62	14.5
C	2.88	2.88	2.88
D ³	100	100	100
$\frac{PA}{DA} \times ET_P = \frac{EHP \times C}{D^3 \times V}$	2.79	2.09	1.687
SBC	.7	.7	.7
$\frac{PA}{DA}$	.31	.248	.22
PC	.677	.704	.708
$IHP = \frac{EHP}{PC}$	2,510	1,610	1,200
10^s	5.344	3.504	2.597
$IHP_p = IHP \div 10^s$	470	460	462
K	1.225	1.225	1.225
$IHP_a = IHP_p \times K$	576	564	566
V ₁	19.746	15.852	13.787
$P = (D \times V) \div V_1$	8.89	9.85	10.5
S	.081	.077	.076
V ^r	4,365	3,310	2,400
v ^r	871	871	871
$s = \frac{S \times IHP_a \times V^r}{IHP \times v^r}$	.0932	.103	.099
1-s	.9068	.897	.901
$R_d = \frac{v \times 101.33}{P(1-s)}$	120.5	114.7	107.2

TABLE 3.—FERRY BOAT (ELECTRIC DRIVE).
HULL DATA

$$LWL = 191. \quad B = 44. \quad H = 13. \quad \frac{B}{LWL} = .23. \quad N.B.C. = .4.$$

After Screw	Forward Screw
$\frac{PA}{DA} = .248$	$\frac{PA}{DA} = .248$
$P = 9.85$	$P = 9.85$
$D = 10$	$D = 10$
$SBC = .7$	$SBC = 0$
$K = 1.225$	$K = 1$
$S = .077$	$S = .205$
$V = 15.6$	$V = 13.45$
$\frac{v}{V} = .641$	$\frac{v}{V} = .744$
$IHP = 1,610$	$IHP = 1,610$
$PC = .704$	$PC = .704$
$EHP = 1,133$	$EHP = 1,133$
$ehp = 340$	$ehp = 340$
$\frac{ehp}{EHP} = .300$	$\frac{ehp}{EHP} = .300$
$10^* = 3.504$	$10^* = 3.504$
$IHP_p = 460$	$IHP_p = 460$
$IHP_A = 564 = 460 \times 1.225$	$IHP_A = 460$
$V^* = 3,310$ (taken between X and Y Sheet 21)	$V^* = 2,410$
$v^* = 871$ (taken from Y Sheet 21)	$v^* = 1,000$
$s = .103$	$s = .142$
$1 - s = .897$	$1 - s = .858$
$R_A = 114.7$	$R_A = 119.8$

$$IHP_A \text{ (total)} = 564 + 460 = 1,024.$$

$$ehp \text{ (total)} = 680.$$

$$ehp \text{ (due to ship alone)} = \frac{680}{1.37} = 496.$$

The increase of 37 percent in effective horsepower will therefore be used in comparing method of propulsion (4) with methods (1) and (2).

COMPARISON OF METHODS (1) AND (2)

The ferry boat proposed by Mr. Dickie was to be driven by two screws, one at each end of the ship, each being driven by an electric motor. Power was to be supplied by two Diesel driven generators of about 500 horsepower each. The data given for the hull were not entirely complete, so it has been necessary to make certain assumptions to complete the work, but as all the work is comparative, the accuracy of these assumptions will not in any way affect the results.

In each case the Dyson method of design and analysis of propellers has been followed.

Table 2 gives the design of a propeller where it has been assumed that the forward and after screws are free to run at different speeds, that the two screws deliver the same effective horsepower in propelling the ship, that 680 effective horsepower will be required to propel the ship at a speed of 10 knots, and that half of this effective horsepower is de-

TABLE 4

If both propellers run at same speed, $S = .120$ and $R_A = 116.9$

$IHP_A \text{ (a)} = \frac{12 \times 1,610 \times 871}{.077 \times 3,310} = 656$	$IHP_A \text{ (t)} = \frac{12 \times 1,610 \times 1,000}{.205 \times 2,470} = 389$
$IHP_p = \frac{656}{1.225} = 531$	$IHP_p = 389$
$10^* = 3.015 = \frac{IHP}{IHP_p}$	$10^* = 4.115 = \frac{IHP}{IHP_p}$
$\frac{ehp}{EHP} = .3465$	$\frac{ehp}{EHP} = .2570$
$ehp = 390$	$ehp = 290$

$$ehp \text{ (total)} = 390 + 290 = 680.$$

$$IHP_A \text{ (total)} = 656 + 389 = 1,045.$$

$$\text{Increase of } IHP_A = 1,045 - 1,023 = 22 = 2.15 \text{ percent.}$$

TABLE 5.—ELECTRIC DRIVEN FERRY BOAT

	10	10
D	10	10
$\frac{ehp}{EHP}$	.4	.5
ehp	496	496
EHP	1,240	992
v	10	10
$\frac{v}{V}$	.69	.73
V	14.5	13.7
C	2.88	2.88
D^*	100	100
$\frac{PA}{DA} \times ET_p = \frac{EHP \times C}{D^* \times V}$	2.463	2.085
SBC	.7	.7
$\frac{PA}{DA}$	.276	.248
PC	.694	.704
IHP	1,787	1,408
10^*	2.597	2.058
IHP_p	688	684
K	1.225	1.225
IHP_A	843	838
V^*	17.60	15.852
$p = \frac{D \times V}{V^*}$	8.2	8.65
S	.079	.077
V^*	2,400	2,000
v^*	871	871
s	.1022	.1052
$1 - s$	.898	.8948
R_A	137.5	131

$$IHP_A = 838.$$

$$\text{Saving in } IHP_A = 1,024 - 838 = 186 = 18.1 \text{ percent, or } 1,045 - 838 = 207 = 19.8 \text{ percent.}$$

livered by each screw. From Table 2 it will be seen that the screw given in the second column is the most efficient and the most suitable for the proposition and this one has been

TABLE 6

	Single Screw	Twin Screws
LWL	324	324
B	47	47
H	21	21
$\frac{B}{LWL}$ }	.145	.145
NBC	.76	.76
KBC	.786	.685
K	1.23	1.325 = thrust deduction
$\frac{H}{B}$ }	.447	.447
SBC	.817	.725
$\frac{2LAB}{H}$ }	10.3	10.3
S	.21	.255
D	16	12 = diameter
P	14.75	10.5 = pitch
$\frac{PA}{DA}$ }	.25	.35 = projected area divided by disk area
TS	6,000	7,650
ITD	2.75	4.85
V	13.71	15.68
v	10	10 = speed
$\frac{v}{V}$ }	.729	.638
IHP	4,240	5,100
PC	.703	.653
EHP	2,980	3,330
ehp	910	480 = effective horsepower
$\frac{ehp}{EHP}$ }	.305	.144
10^3	3.444	7.524
IHP _a	1,517	898 = indicated horsepower
Z	— .5365	— .880
Z _a	+ .302	+ .480
Z + Z _a	— .2345	— .400
s	.1506	.1345
1 — s	.8494	.8655
R _a	81	111.5 = revolutions per minute

$$2 \times 480 = 960.$$

$$960 - 910 = 50.$$

$$\frac{960}{910} = 1.055, \text{ or } 5.5 \text{ percent increase.}$$

$$1.325 - 1.23 = .095.$$

$$\frac{1.325}{1.23} = 1.077, \text{ or } 7.7 \text{ percent increase.}$$

$$5.5 + 7.7 = 13.2 \text{ percent increase to use of twin screws.}$$

$$2 \times 898 = 1,796.$$

$$\frac{1,517}{.87} = 1,745.$$

$$1,796 - 1,745 = 51.$$

TABLE 6 (Continued)

$$\frac{51}{1,745} = .029 = 2.9 \text{ percent.}$$

selected. The design is for the after end of the ship. An analysis of this propeller for both ends of the ship is given in Table 3.

A further analysis of this screw, assuming the same speed at both ends of the ship, is given in Table 4. From Table 4 it will be seen that this method (1) requires an increase of 22 horsepower, or 2.15 percent more than (2). This indicates that very little gain is to be expected by the use of method (2) instead of method (1). In other words, the method of propulsion now in use gives practically as good results as would be obtained by running two screws at slightly different speeds so as to have them deliver equal effective horsepowers and somewhat more nearly equal indicated horsepowers. There would, however, be a slight increase in motor efficiency due to the more nearly equal loading of the two motors, so that the total increase in efficiency of propulsion would be sufficient to warrant the use of method (2) instead of method (1).

COMPARISON OF METHOD (4) WITH (1) AND (2)

It will now be shown that method (4) is more efficient than any of the other propositions. Table 5 shows the design of a screw where all the power is to be developed by the after screw, and, since there is no race from the forward screw, the effective horsepower required to be delivered will be 680 divided by 1.37, or 496.

The screw given in the second column of Table 5 will be selected, as it is the more efficient. It will be noted that $\frac{PA}{DA}$

is .248, or the same as was selected for the screw where two screws were to drive the ship. Since the screw at the forward end of the ship is not delivering any power, it will not be necessary to make a further analysis of this screw other than that contained in Table 5. From Table 5 it will be seen that the indicated horsepower required to drive the ship is only 838. This represents a saving of 18.1 percent over method (2), or a saving of 19.9 percent over method (1). From this saving there will have to be subtracted the horsepower required to turn the forward screw at a speed just sufficient to keep it from acting as a drag on the ship. While it is not known exactly what this indicated horsepower will be, experiments in a model tank have indicated that it will be very small, not more than about 4.5 percent, which will leave a gain of 13.6 percent in the first case and 15.4 percent in the second case. From this comparison it will be seen that the gain in efficiency due to the use of electricity for propulsion more than makes up for the electric conversion losses, for which 13 percent may be taken as a maximum.

LOW POWERED CARGO VESSELS

In the case of cargo vessels of about 10 knots, requiring about 1,500 shaft horsepower, the use of Diesel electric propulsion instead of direct connected Diesel propulsion also shows up remarkably well. In the following comparison it will be assumed that twin screws will be required for a direct connected installation and that a single screw can be used for the Diesel electric drive.

Two screws have been designed for these conditions, it being assumed that with Diesel engines, direct connected, a speed of at least 110 revolutions per minute will be required. The effective horsepower required in the case of the single screw will be 910.

In Table 6 is given an analysis of the two screws by the Dyson method. Owing to increased appendage resistance (struts), as shown by Sheet No. 18 of Dyson's book, the

effective horsepower required for twin screws will be 960 instead of 910, or an increase of $5\frac{1}{2}$ percent. With twin screws the thrust deduction is 1.325; with a single screw it will be only 1.23, or a difference of $9\frac{1}{2}$ percent. The actual increase of indicated horsepower due to increased thrust deduction will be 1.325 divided by 1.23, which equals 1.077, or an increase of 7.7 percent. The total increase due to the use of twin screws therefore will be $5\frac{1}{2}$ percent plus 7.7 percent, which equals 13.2 percent, or just a little more than the electrical losses. However, it is shown in Table 6 that the total indicated horsepower required for the direct connected engine is 1,796, while that required for the Diesel electric installation is only 1,745, or a difference of 2.9 percent in favor of the Diesel electric drive. This difference is due to the fact that a more efficient screw can be designed for the low revolutions that can be used with a motor than for the high revolutions that are required for the direct connected Diesel engines.

ECONOMY OF DIESEL ELECTRIC INSTALLATION

This brings out the rather remarkable fact that for low powered cargo vessels the Diesel electric installation is actually somewhat more economical than the direct connected Diesel. When in addition the question of flexibility and reliability are considered, the advantages of the Diesel electric installation are so great that shipbuilders cannot afford to ignore it.

In the foregoing comparison three-bladed screws were used for the cargo vessel, but the comparison would hold equally well for four-bladed screws. It is probably well to emphasize the fact that the main difference between the two propulsive efficiencies is due to the inherent difference between single screw and twin screw installations, and not between the actual propellers themselves.

SYMBOLS

The symbols used in the above tables, which are the same as those set forth in Dyson's book on Screw Propellers, are defined as follows:

- L.W.L.* = length on load waterline.
B = beam.
H = draft.
N.B.C. = nominal block coefficient.
P.A.
 $\frac{D.A.A.}{P.A.}$ = projected area ratio of 4-bladed propeller.
 $\frac{D.A.}{P.A.}$ = projected area ratio of 3-bladed propeller.
P = pitch of propeller in feet.
D = diameter of propeller in feet.
S.B.C. = slip block coefficient of vessel.
K = thrust deduction factor.
V = basic speed corresponding to *E.H.P.*
v = actual speed of vessel corresponding to *e.h.p.*
R_a = revolutions for *E.H.P.*
s = apparent slip of propeller at speed *v*.
I.H.P. = indicated horsepower corresponding to *E.H.P.* (basic).
P.C. = propulsive coefficient corresponding to actual projected area ratio.
E.H.P. = effective horsepower which can be delivered by the propeller under basic conditions.
S = apparent slip of propeller at basic speed *V* under basic conditions of power and resistance.
y = values of exponents in *V^y* and *v^y* in equation for making an estimate of revolutions due to a change in conditions resulting from change in power accompanied by corresponding change in speed.
I.H.P._p = indicated horsepower of propelling engine without thrust deduction.
I.H.P._A = indicated horsepower of propelling engine with thrust deduction.
e.h.p. = net effective horsepower required to tow the hull at any given speed, the hull being fitted with all appendages.

C = constant.

ET_p = effective thrust of propeller per square inch of projected area.

$\frac{T.S. \times (1-s)}{\pi \times 101.33}$ (used only to simplify calculations).

KBC = thrust deduction block coefficient.

2LAB = twice the length of the after body.

TS = tip speed of propeller in feet per minute under basic conditions.

ITD = indicated thrust per square inch of disk area of the propeller under basic conditions.

Z = value of exponent in the equation for power at other than basic condition.

Z_s = value of exponent in equation for slip at other than basic condition.

Leaky Boiler Joints

THE danger arising from non-attendance to a leaky boiler joint was recently demonstrated on a dredger, with results that might well have proved fatal. The joint at a manhole door blew out, with the result that the contents of the boiler were emptied into the engine room, severely scalding the engineer, but, happily, without fatal results. It was proved at the subsequent Board of Trade inquiry that as a result of corrosion around the flange of the boiler plate, and also on the spigot of the door itself, the door was a very slack fit in the manhole, and, owing to the absence of attention and tightening up while pressure was being raised, the joint was forced between the spigot and the flange. The actual amount of slackness due to corrosion amounted to no less than 25/32 inch, instead of about $\frac{1}{8}$ inch in any one direction, which was the amount when the new doors were fitted. The leakage of steam or water at any point is always the cause of rapid corrosion, and apart from the danger of weakening the plates, if the corrosion is such that it takes away the support at the side of the joint, it is liable to lead to blowing out of the latter. It may be mentioned that, in good practice, manhole doors are recessed to take the flange, with the result that the joint has support on both sides, thus reducing considerably the possibility of it being blown out.

Pipe Bending Hints*

BY W. F. SCHAPHORST, M. E.

AFTER fifteen years of experience with work involving pipe bending, it occurs to me that the following precautionary remarks may be of value or interest:

In bending large pipe, fill with dry sand and plug the ends. Heat to a red heat in localities to be bent and bend. Be sure that the sand is dry. Where bends are slight it is often unnecessary to use sand or rosin. The object of sand or rosin is simply to keep the side of the pipe from collapsing or to prevent reduction of flow area. If wet sand is used and if the ends are plugged, the pipe may burst when heated, due to the steam pressure generated.

Rosin, also, is good. But there is a "right way" and possibly several wrong ways to use it. An example of a wrong way was recently brought to my attention where a "mechanic" filled the pipe with rosin, plugged the ends and heated the pipe at the place where he wanted to bend it. He watched for a "red heat" just as he would had he filled the pipe with sand. The result was a violent explosion.

The way to use rosin is to pour it into the pipe and allow it to cool and harden. As soon as the rosin is hard, bend the pipe cold. Don't heat it. Then, after the pipe is bent, heat the pipe all over sufficiently to melt and remove the rosin.

There are many excellent mechanical devices on the market for bending pipe. To bend large, stiff pipe slightly and inexpensively there is nothing handier or more efficient, in my judgment, than a hydraulic pipe bender driven by a hand pump.

* Copyright, 1920, by W. F. Schaphorst.

Shipping Under the New Administration

"Under New Management" Sign May Be Put Up Over the Office of the Government-Owned Merchant Marine

BY WALDON FAWCETT

ONE effect of the decisive Republican victory in the national election in November is to push to the fore, with greater emphasis than it would otherwise enjoy, the question whether there shall be a complete reorganization of the administration of the nation's governmentally-owned merchant marine. With a Republican President in the White House and with the party in power fortified by a "working majority" in each house of Congress, it is obvious that there is unquestioned opportunity to put over a new plan for the operation of Uncle Sam's merchant tonnage if such revolutionary action finds approval as a principle of party policy.

There is no justification, it should be pointed out just here, for a suspicion that the projected shake-up of merchant marine administrative machinery is due simply to the accession to power of the political party opposite to that which instituted the United States Shipping Board. As a matter of fact there has been, ever since the close of the war, an element of the membership of Congress that has been dissatisfied with the existing executive organization that has administered the Federal merchant fleet. This dissatisfaction has been directed not so much against individuals as against the system.

UNREST MAY LEAD TO REORGANIZATION

Manifestation of the unrest was found in the proposal in Congress in the early summer of 1919 that the Shipping Board be abolished and there be substituted a new Federal department with a Cabinet officer at its head. It is no secret, either, that Senator Jones, author of the recently enacted Merchant Marine Act, would have preferred that the entire responsibility for the construction, operation and upkeep of government-owned vessels be taken out of the hands of the Shipping Board and vested in a separate operating corporation. In short, he would have been better satisfied had the new law provided for a shipping corporation that would have borne to the Shipping Board somewhat the same relation that the United States Railroad Administration bore, during its existence, to the Interstate Commerce Commission. He was induced to relinquish this ideal only when fellow Senators pointed out the expense to the Government of a separate organization of the kind proposed.

On the part of some persons there may be surprise that there should be such store set by the form of the nation's "shipping annex" when it is the popular understanding that Uncle Sam is to retire as speedily as possible from the ownership and operation of merchant tonnage. In answer to that it may be said that most well-informed men in the shipping and shipbuilding field realize that, whatever the intent, it will not be possible for the Government to retire from its merchant marine enterprise as abruptly as a section of the lay public expects. Indeed, it is clearly within the realms of possibility that Uncle Sam will continue shipping operations indefinitely, albeit on a gradually diminishing scale. This continuance is, indeed, implied by the obligation that has been assumed to maintain "adequate" service between the continental United States and the nation's various insular possessions.

THE CASE OF MARINE INSURANCE

In further proof of the certainty of continued governmental participation in merchant marine activities and kindred responsibilities it may be permissible to digress just here to

cite the illustrative example of marine insurance. As realization grows that American private capital will not be able to make headway in the provision of marine insurance unless there be wider latitude for combination and that such leniency waits upon legislation in a number of different states of the Union there is a growing conviction on the part of many members of Congress that there is nothing for it but for the National Government to take the role of marine underwriter. Yet another factor that insures prolonged contact between the Government and private shipping and shipbuilding interests is that involved in the "adjustments" to be made on war contracts. The delay in the settlement of the claims of the wooden shipbuilders indicates how tedious is this process and accounts for the interest that must be felt in the Federal machinery for marine administration even by the men within the industry who expect to have no further participation in the governmental programme after the current incidents are closed.

HARDING'S ATTITUDE

President-elect Harding is known to have definite and well-considered convictions on the subject of the American merchant marine, and future history in this quarter will, manifestly, be influenced by his application of these principles to the problem of administrative policy. The temper of Congress on the issue will be determined in no small degree, it is expected, by the tenor of the final report to be submitted by a special committee of the House of Representatives, which has been engaged, for some months past, in an investigation of the Shipping Board. This committee, of which Representative Walsh of Massachusetts is chairman, continued its investigation during the recess of the National Legislature. A report will be ready for submission early in the final session of the 66th Congress, but it remains to be determined whether this report will stand as the committee's complete verdict or whether it will have the status of a preliminary report to be followed later by conclusions adduced in the light of the latter-day activities of the Shipping Board.

On the part of at least a portion of the members of the special Congressional committee the revelations incident to the above-mentioned investigation of the Shipping Board have but deepened the conviction already held that the management of the government-owned merchant marine should not be left solely to the discretion of an independent and more or less isolated branch of the Government, but should be vested in an organization closely interlocked with the several executive departments and with a spokesman in the Presidential Cabinet who would be in a position at all times to voice the needs and aspirations of the maritime establishment and enlist whatever measure of co-operation might be necessary. In short, the logic of members of this school of thought is that whereas the Shipping Board may have been well enough as a war-time expedient it is not the ideal cog to fit permanently into the established governmental machine.

SPECIALIZATION IN THE SHIPPING BOARD

Even among Republican Senators who are more or less friendly to the principle of the Shipping Board as now existent and who are little inclined to uproot the structure, if satisfactorily capable appointments are made, there is a growing sentiment to the effect that, for the best interests of the merchant marine, there must be a distribution or segregation

of responsibilities that will permit specialization within the organization. What is in mind is a plan of organization whereby one member of the Board would be at the head of a division of operations, that would have jurisdiction over charters and all the technicalities of shipping service; a second member of the Board would be in charge of "construction," and so on through the list of activities into which the complex responsibilities of the Shipping Board might naturally be subdivided.

It is recognized that such a programme of apportionment of responsibility is seemingly contrary to the spirit of the present specification which contemplates a Shipping Board sitting in council as a board of directors with representatives for the several geographical districts that have maritime interests. Champions of the new proposal insist, however, that it is more important that there be maximum specialization in accordance with technical grand divisions than that a geographical balance of power be reflected in the personnel of the Board. Moreover, they insist that specialization in the delegation of executive authority might be undertaken without disturbing the arrangement which calls for the appointment of two members of the Board from the Atlantic coast, two from the Pacific coast, one from the Gulf coast, one from the territory contiguous to the Great Lakes, and one from the interior.

The germ of the idea that bids fair to take conspicuous form in the near future was implanted during the meetings of the Committee on Commerce of the United States Senate, which resulted ultimately in the drafting of what was to go on the Federal statute books as the Merchant Marine Act. For example, during the conferences of the committee with prominent shipping men, Mr. Fields S. Pendleton, of New York, shipbuilder, shipowner and ship operator, pleaded eloquently for the retention of all the large vessels (passenger as well as cargo carriers) acquired by the Government during the war and for their operation under Government control or Government supervision.

GOVERNMENT CORPORATION SUGGESTED

While he did not elaborate his suggestion, Mr. Pendleton left with the Commerce Committee the basic proposal that the ships be turned over to a corporation which, for all that it would be separate and distinct from the Shipping Board,—a Government subsidiary, in a sense,—would nevertheless partake of many of the characteristics of a private corporation. In the original outline it was suggested that there be Government representatives, such as a representative of the Department of Commerce, on the board of directors, but that the ship operating corporation be left free to work out its own salvation in its own way so long as it was enabled to make satisfactory reports to the Government.

Chairman Jones, who fathered the Merchant Marine Act that bears his name, expressed from the outset considerable sympathy with this idea. On one occasion when Mr. Pendleton had suggested that the Panama Steamship Company might perhaps serve as a model for an operating corporation to carry on the Government's shipping enterprises, Senator Jones commented: "I think that there is a good deal of force in the suggestion. I think that a Government corporation organized so as to run like a private corporation is the thing. We never hear anything about the Panama Steamship Company and its operations. Nobody suggests it is influenced politically. Yet it is going right on, doing business, suing and being sued; in short, doing business like a private corporation."

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While not even the most radical advocates of a reorganization of Uncle Sam's maritime administration admit that it would necessarily involve a reopening of the question of the partial "nationalization" of our merchant marine, there is recent and graphic illustration of the fact that, on the eve of a change of national executive administration, no predetermined policy can be regarded as a closed incident. The example to the contrary is found in the prospective opening of the question of Panama Canal tolls—something that has potent if indirect bearing upon the status of the American merchant marine. The pledge in the Republican platform, the comment in Senator Harding's speech of acceptance and the journey to Panama of the President-elect for the purpose of studying the problem at first hand, all bespeak the likelihood of a reversal of policy on Panama Canal tolls. And, by the by, far-sighted students of international relations foresee, as the possible sequel to such reversal, a new competitive tension between maritime Britain and maritime America that may bring in its train as a necessity that very permanent Governmental participation in the shipping industry which has appeared to many so remote a contingency.

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The Morning After

The Shipping "Jag" Is Over—A Period of Reform and New Resolves Must Be Faced

BY "OLD SCOTCH"

I WONDER how many men there are in the shipping game who have awakened at some time in the morning and wondered just where he had been the night before and what he had done! Those of you who have been that way, please stand up and be counted! Now don't crowd the main aisles! Stand up where you are. That will do, thank you. I see the ayes have it, so there is no need of counting. Anyhow, it won't happen again very soon, I'll bet, unless you all go abroad or have a stand-in with the bootleggers.

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the world that you henceforth will lead an upstanding and exemplary life. Away with all foolishness, now for straight out business!

Those feelings and sentiments, dear readers, are exactly what the people in the shipping business are now going through or are about to encounter. We have been on a gigantic jag for the past three or four years, and the cold, gray dawn of the morning after is peeking through the blinds. Whether you are a shipbuilder or a riveter, a chief engineer or a coal passer, you must realize that you have got to go through a period of reform and new resolves. Shipowners are no longer going to importune you to build their vessels at almost any price you name, nor are foremen or chief engineers going to beg you to work for them at fancy wages, which will be increased every time you think you need a new silk shirt or a new set of tires for your Ford limousine. We are all going to get down to brass tacks and cut out all foolishness. Men in the shipyards will have to deliver eight hours' good solid work every day and cut out all loafing and crap shooting, or they will find that the boss has a half dozen men waiting for the jobs the malingersers don't appreciate. Men on the ships will have to deliver a proper return for their pay, and do most of their own repairs as they formerly were glad to do, or there won't be any ship to sail on; then back to the boarding houses where you can only stay so long as your coin holds out.

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of responsibilities that will permit specialization within the organization. What is in mind is a plan of organization whereby one member of the Board would be at the head of a division of operations, that would have jurisdiction over charters and all the technicalities of shipping service; a second member of the Board would be in charge of "construction," and so on through the list of activities into which the complex responsibilities of the Shipping Board might naturally be subdivided.

It is recognized that such a programme of apportionment of responsibility is seemingly contrary to the spirit of the present specification which contemplates a Shipping Board sitting in council as a board of directors with representatives for the several geographical districts that have maritime interests. Champions of the new proposal insist, however, that it is more important that there be maximum specialization in accordance with technical grand divisions than that a geographical balance of power be reflected in the personnel of the Board. Moreover, they insist that specialization in the delegation of executive authority might be undertaken without disturbing the arrangement which calls for the appointment of two members of the Board from the Atlantic coast, two from the Pacific coast, one from the Gulf coast, one from the territory contiguous to the Great Lakes, and one from the interior.

The germ of the idea that bids fair to take conspicuous form in the near future was implanted during the meetings of the Committee on Commerce of the United States Senate, which resulted ultimately in the drafting of what was to go on the Federal statute books as the Merchant Marine Act. For example, during the conferences of the committee with prominent shipping men, Mr. Fields S. Pendleton, of New York, shipbuilder, shipowner and ship operator, pleaded eloquently for the retention of all the large vessels (passenger as well as cargo carriers) acquired by the Government during the war and for their operation under Government control or Government supervision.

GOVERNMENT CORPORATION SUGGESTED

While he did not elaborate his suggestion, Mr. Pendleton left with the Commerce Committee the basic proposal that the ships be turned over to a corporation which, for all that it would be separate and distinct from the Shipping Board,—a Government subsidiary, in a sense,—would nevertheless partake of many of the characteristics of a private corporation. In the original outline it was suggested that there be Government representatives, such as a representative of the Department of Commerce, on the board of directors, but that the ship operating corporation be left free to work out its own salvation in its own way so long as it was enabled to make satisfactory reports to the Government.

Chairman Jones, who fathered the Merchant Marine Act that bears his name, expressed from the outset considerable sympathy with this idea. On one occasion when Mr. Pendleton had suggested that the Panama Steamship Company might perhaps serve as a model for an operating corporation to carry on the Government's shipping enterprises, Senator Jones commented: "I think that there is a good deal of force in the suggestion. I think that a Government corporation organized so as to run like a private corporation is the thing. We never hear anything about the Panama Steamship Company and its operations. Nobody suggests it is influenced politically. Yet it is going right on, doing business, suing and being sued; in short, doing business like a private corporation."

THE OPPOSITION

There is a certain element in Congress and outside that is antagonistic to any plan for setting up an operating administration to take over the Government-owned tonnage for fear that the mere fact that there is an operating company ready

to hand will tend to persuade the retention of Government tonnage instead of its speedy disposition by outright sale to private parties. This portion of the body politic would fain see Uncle Sam relinquish, with the least possible delay, all responsibilities as a shipowner and ship operator and is apprehensive of any new influence that might tend to give permanence to the war-time arrangements. Arrayed against this contingent is one of equally resolute purpose that favors retention and operation of the ships by the Government. In justification of this latter attitude it is represented that "the great fear" of other maritime nations is that the United States Shipping Board will continue to hold its fleet. By way of evidence to prove that the United States should do precisely what her greatest rivals desire that she shall not do there has been extensively quoted in the discussions at Washington the statement of Lord Inchcape, president of the Peninsular & Oriental Steamship Company, in the seventy-ninth annual report of that corporation, in which he expressed the hope that the Government of the United States "will leave the shipping industry to look after itself."

While not even the most radical advocates of a reorganization of Uncle Sam's maritime administration admit that it would necessarily involve a reopening of the question of the partial "nationalization" of our merchant marine, there is recent and graphic illustration of the fact that, on the eve of a change of national executive administration, no predetermined policy can be regarded as a closed incident. The example to the contrary is found in the prospective opening of the question of Panama Canal tolls—something that has potent if indirect bearing upon the status of the American merchant marine. The pledge in the Republican platform, the comment in Senator Harding's speech of acceptance and the journey to Panama of the President-elect for the purpose of studying the problem at first hand, all bespeak the likelihood of a reversal of policy on Panama Canal tolls. And, by the by, far-sighted students of international relations foresee, as the possible sequel to such reversal, a new competitive tension between maritime Britain and maritime America that may bring in its train as a necessity that very permanent Governmental participation in the shipping industry which has appeared to many so remote a contingency.

PRESIDENT-ELECT'S TRIP TO PANAMA

The intimation from authoritative source that the trip of the President-elect to Panama is but the first step in a thorough study, in the most intimate possible manner, of the whole problem of the uplift of the American merchant marine may impel that section of Congress which always awaits to the initiative of the White House to postpone until after March 4 any effort for a shake-up in Uncle Sam's shipping offices. There remains to be reckoned with, however, a section of Congressional opinion that holds that reorganization should not be delayed a day longer than necessary. The hand of this player in the legislative game has been strengthened by the spectacle of one or two men functioning, in effect, as the Shipping Board, and will be further strengthened, perhaps, by some of the disclosures in the forthcoming report of the investigation of the Shipping Board.

In the interest of an accurate statement of the situation, it cannot be made too clear that there are members of Congress, not inconsiderable in number, who favor substitution of a Federal executive department for the Shipping Board, but who will not for a moment concede that such a shift of responsibility should carry with it any abridgment of the policy which would take Uncle Sam out of the ranks of merchant ship owners and operators. These antis on Government ownership are ready to echo the sentiment of Admiral W. S. Benson, chairman of the Shipping Board, when he said at a recent dinner: "Gladly I would, and do, pledge myself to help see that not only my own but other govern-

ments be brought to a point where they fully agree to retire absolutely from ocean carriage which could only mean uneven competition with the private owner."

CENTRALIZATION OF ADMINISTRATIVE CONTROL

Some of the most earnest advocates of a new form of shipping structure at Washington are imbued principally by a desire for the centralization of administrative control of all the Governmental agencies having to do with ships, shipbuilding and commerce. To that end they would have the Federal department, if one be created, include not merely all the responsibilities and functions now within the province of the Shipping Board, but likewise the various existing establishments dealing with maritime affairs, viz., the Coast Guard, the Bureau of Fisheries, the Bureau of Lighthouses, the Bureau of Navigation, the Steamboat Inspection Service, the Inland Waterways Commission, etc. The consideration of economy through consolidation is expected to prove the practical promise that will win for this project the heaviest support in Congress, for Congress is plainly exercised just now over the waste that results from "duplication" of Government work, thanks to parallel activities in different departments. But, overshadowing in the minds of well-wishers of the merchant marine these considerations of immediate practicability is the large one that a Federal department of marine would provide a specific Governmental agency that could at all times work consistently for the fostering, promotion and development of the merchant marine.

Finally, there have appeared very recently developments, actual or prospective, in international relations that make it appear that, for the sake of diplomacy, it might be most helpful to have the United States merchant marine administration most closely co-ordinated with the other principal branches of the Government and with a voice in Cabinet councils. The impending resurrection of the question of Panama Canal tolls has already been mentioned, and it may have more ramifications than most marine men may suspect, extending mayhap to the question of tolls at the Suez and other canals and even to the remotely related question of naval armaments. The abrogation or amendment of existing commercial treaties, as prescribed in the new Merchant Marine Act, presupposes extended international negotiation and friction over merchant marine policies has lately been injected into the relations between the United States and Japan. The United States laws relative to coastwise traffic also continue to irritate some other nations, as witness the recent remarks of Sir Auckland Geddes, British ambassador, as to the "far-reaching derangements" that might result should the British Empire say tit for tat. And, finally, the impending general revision of the United States tariff laws, which is slated for the first session of the 67th Congress, is almost certain to beget reactions in international trade that will affect the American merchant marine and consequently make it desirable that there be complete harmony between the United States merchant marine policy and the general Government policies.

The Morning After

The Shipping "Jag" Is Over—A Period of Reform and New Resolves Must Be Faced

BY "OLD SCOTCH"

I WONDER how many men there are in the shipping game who have awakened at some time in the morning and wondered just where he had been the night before and what he had done! Those of you who have been that way, please stand up and be counted! Now don't crowd the main aisles! Stand up where you are. That will do, thank you. I see the ayes have it, so there is no need of counting. Anyhow, it won't happen again very soon, I'll bet, unless you all go abroad or have a stand-in with the bootleggers.

I merely wanted to ascertain if you could understand the title of this brief sketch I'm going to give. I have read a great deal about the symptoms in books, but was afraid you might not have been so fortunate. According to pages 1 to 5 of chapter I of the book I read the dope in, the victim is supposed to sit up in bed, pry his eyes open one at a time, look around to see if his clothes are all there, reach out for his vest and find if his watch is there and going, then count the money in his various pockets, if there be any remaining. As consciousness gradually asserts itself, dim recollections of feeling rich the night before, everything looking roseate, fine companionship and funny incidents flash across his fevered brain. Then follow sharp pains in the head and a burning desire for ice water. Normally the next thing to do is to crawl out of bed, pull on your disordered raiment, and utter great vows of "never again." You are in a humble and apologetic mood with all the world, and firmly resolve that thereafter you will stick in the straight and narrow path, work hard, save your money, buy your wife a new hat, get Willie a set of tools he has yearned for, and in general show

the world that you henceforth will lead an upstanding and exemplary life. Away with all foolishness, now for straight out business!

Those feelings and sentiments, dear readers, are exactly what the people in the shipping business are now going through or are about to encounter. We have been on a gigantic jag for the past three or four years, and the cold, gray dawn of the morning after is peeking through the blinds. Whether you are a shipbuilder or a riveter, a chief engineer or a coal passer, you must realize that you have got to go through a period of reform and new resolves. Shipowners are no longer going to importune you to build their vessels at almost any price you name, nor are foremen or chief engineers going to beg you to work for them at fancy wages, which will be increased every time you think you need a new silk shirt or a new set of tires for your Ford limousine. We are all going to get down to brass tacks and cut out all foolishness. Men in the shipyards will have to deliver eight hours' good solid work every day and cut out all loafing and crap shooting, or they will find that the boss has a half dozen men waiting for the jobs the malingerers don't appreciate. Men on the ships will have to deliver a proper return for their pay, and do most of their own repairs as they formerly were glad to do, or there won't be any ship to sail on; then back to the boarding houses where you can only stay so long as your coin holds out.

Like the man recovering from the "night before," we are all in a condition to make many new resolutions and start in to put them in effect. In the shipping business there is now

and will probably be for some months to come plenty of work for those who will work efficiently, but the day of the slacker and the malingerer has passed into one of those dreams of the good time we all had the night before. If you don't believe it, just continue the way some of you are still going and see how long it will be before someone slips you a blue ticket and an order on the paymaster for all time to date.

Don't worry about the high cost of living—that is on the slide, too; just look at what has happened and is happening to the various profiteers. The "jag" is over for them as well as it is for you. Some of them will get away with the rough stuff they are still forcing on the public, but their day of reckoning is rapidly approaching. It's an old saying that "what goes up must come down," and we are daily watching the descent of some of our inflated commodities. High prices and high wages are like rows of bricks: as each one goes down it pulls the one nearest to it down on the same level.

Every launching in the shipyards nowadays makes one less ship to work on. There will be other vessels to take their places, just as soon as the costs of material and labor come down to a reasonable basis, and not before. Wages need not come down so much, if you increase your output, but no one who has money is going to put it into new ships where a dollar invested now will be worth only half that much two years hence. Therefore a greater output for the money received on the part of the riveter, the boiler maker and the machinist means more attractive investment for the investor.

For those of you who go to sea there will be plenty of work providing you attend to your business and don't demand wages which no one can pay and make a little for themselves on the side. Many of the men now working in the shipyards can find plenty of employment on the operating ships if they are willing to work hard and watch out for the interests of the owners as well as they look after their own. American ships can't compete with foreigners unless every one on the ships does his best to make it pay to operate them in competition with the ships of all other nations. For the past five years (during the "jag") anything that could keep afloat, no matter how badly it was managed, could make money and everyone formed bad habits, from shipowner to fore-castle boy, thinking that the "jag" would continue indefinitely. The "morning after" had hit shipping almost before any other industry, so the good resolves and resolutions must naturally be put in effect on our ships first.

It is but human nature for any of us to brace up and reform when we feel in a humble attitude. To get in a thoroughly humble condition there is nothing so efficient as being out of a job for a couple of months and "pressing the bricks" as you hunt from shop to shop or from ship to ship trying to connect with somebody's good payroll. Many of you youngsters in the shipping business have never experienced that delightful sensation and never have had the cold December winds chasing through the cracks in your last year's Kelly while you hoof it from place to place and get the frosty stare as your reward. A small amount of experience like that does some of us a lot of good, and just such a condition is coming to us, if we don't do some "next morning" reforming mighty soon. The bills for running our Shipping Board ships in a devil-may-care way won't much longer be paid and no questions asked.

There is a great reform going to be instituted in all shipyards and on-board all American ships. The American people as a whole realized that the "jag" was over,

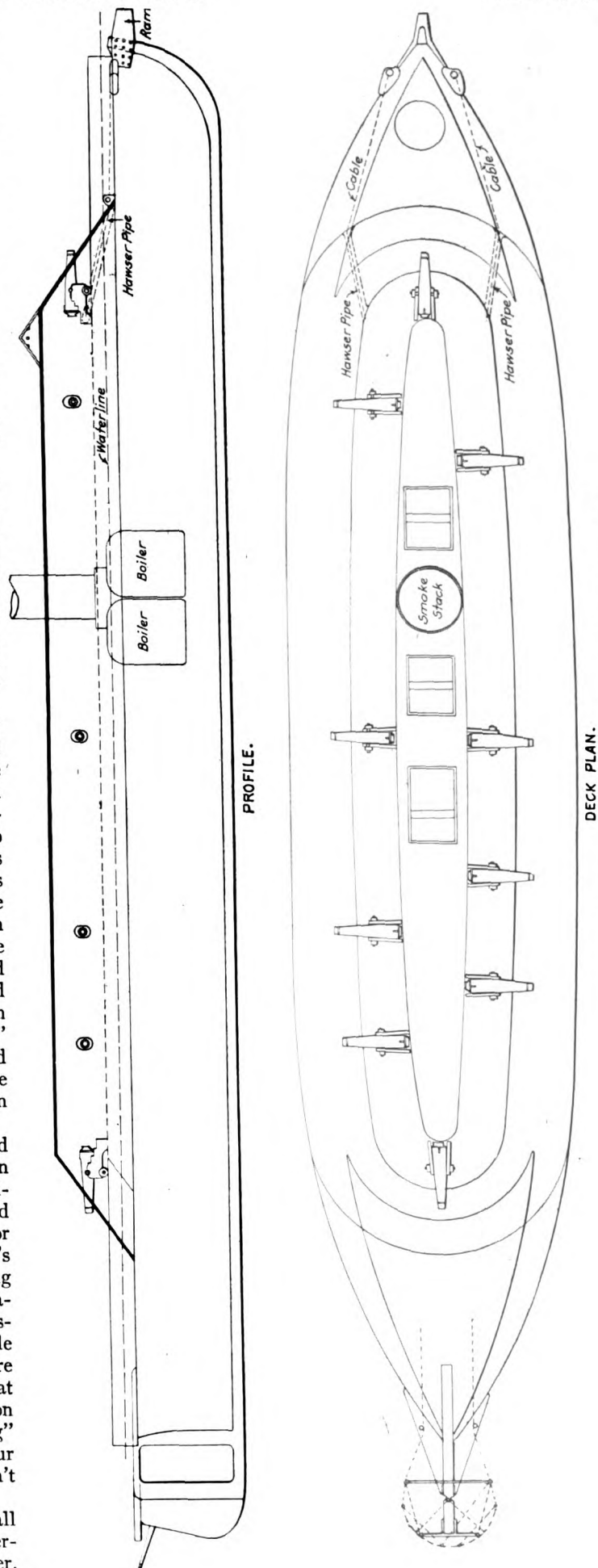


Fig. 1.—Original Plan for Conversion of Steamer Merrimac into an Iron-Clad

and we have got to reform, or else that 6,000,000 popular majority last November 2nd doesn't mean anything. Naturally the easiest way to reform is to begin on the other fellow. That is just what this great political turnover meant, that the "other fellows" who have been running the Government and the Shipping Board have got to stop spending the public money so lavishly. As a matter of fact, the best way to reform in money spending is for each one of us to constitute himself a committee of one to see that we stop wasting our own money individually, and that we try to increase our individual production no matter what part of the shipping game we are engaged in pushing along.

Most "jags," collective or individual, are periods of waste and destruction—seldom is there anything you can count on as an asset when you sum up. In this great national debauch we have indulged in our dear old Uncle Sam wakes up, however, and finds a good-sized fleet of merchant ships on his hands. We, as his crew, want to get ourselves in a good humble attitude and make firm resolves that we are going to put those ships to work and form a real merchant marine, one that can and will compete with the ships of all other nations. "Jag" methods such as we have all been indulging in won't go any longer. Cut out the silk shirts and the diamond rings, get on your patched-up dungarees, and go at the jobs as if you meant it! If you don't begin right away in all American shipyards and on all American ships, that well-known firm of Street, Walker & Company will be taking on lots of new hands.

The First American Iron-Clad—the Merrimac

BY COMMANDER G. A. BISSET, C. C., U. S. N.

THE illustration on the opposite page is a reproduction of the original plans prepared by Naval Constructor John L. Porter, of the Confederate States Navy, for the conversion of the steamer *Merrimac* into an iron-clad.

The vessel was 262 feet 9 inches long from the stem to the after side of the stern post. The distance from the stem to the forward end of the shield or armor was 29 feet 6 inches. The distance from the tiller to the after part of the shield was 55 feet. The length of the shield was 178 feet 3 inches. The shield was fitted at an angle with the horizontal of 35 degrees.

The total thickness of the shield was 4 inches, made up of two layers of iron 12 inches wide by 2 inches thick, one layer being horizontal and the other at right angles thereto. The wood backing was 22 inches thick made up of three layers of wood, each layer being calked. The total estimated cost of the work was \$172,523. The actual cost is not available. The order to start the work was issued on July 11, 1861, and

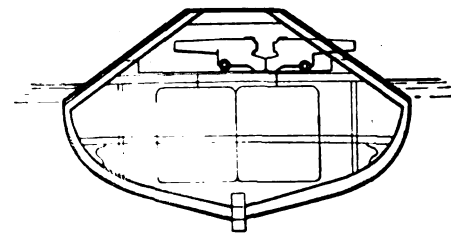


Fig. 2.—Section of *Merrimac*

the *Merrimac* first engaged in battle on March 8 and 9, 1862.

The eaves of the vessel, that is, the lower edge of the armor, as well as the main deck forward and aft of the shield, were 2

feet under water. These decks were protected by one inch of iron. The original armament of the vessel was two 7-inch rifle guns, one at each end, and eight smooth bore 9-inch Dahlgren guns. The draft of the vessel was 21 feet forward and 22 feet aft.

While Mr. Porter did not consider the design of the *Merrimac* a good one, and would not have used that design for a new vessel, it was thought to be the best that could be done in the way of adaptation of the existing vessel, which had been burned to the water's edge. The decks forward and aft, as well as the eaves, being under water, caused the stability of the vessel to be very unsatisfactory, as was recognized by Mr. Porter at the time.

The historical accounts of the battle between the *Monitor* and the *Merrimac*, naturally, being dictated by the eventual victor of the war, favor the opinion that the battle was won by the *Monitor*. The truth of the matter appears to be that the *Monitor* actually withdrew from the fight on March 9 and, moreover, on later occasions refused battle when it was offered by the *Merrimac*.

The *Merrimac* was blown up on May 11, 1862, by order of Commodore Tatnall, her commanding officer, at the time of the evacuation of Norfolk by the Confederate forces. This action of Commander Tatnall, in view of our present knowledge of the effect of the *Merrimac* on the morale of the Union fleet, was a serious tactical error.

Piston Displacement, Velocity and Acceleration for Reciprocating Engines

BY JOHN L. BOGERT*

IT seems rather singular that, in the one hundred and fifty odd years that have elapsed since the combination of crank and connecting rod was suggested for converting reciprocating into rotary motion, no tables of displacement, velocity ratio and acceleration for the reciprocating member of the combination, in terms of the constant angular movement of the rotary member, appear to have been published. For the surveyor and the navigator, to say nothing of the astronomer, tables have been prepared for many years giving every function of every angle, both natural and logarithmic, besides all other data that can in any way shorten their labors. Writers on the reciprocating steam, gas and oil engine, however, have been content to point out the correct mathematical expressions for piston displacement, velocity

and acceleration, and then inform the reader that these expressions are too troublesome to use and that approximations resulting from either the application of the binomial theorem or a Fourier series are much more serviceable. In view of the above, and in an endeavor to lighten the preliminary work for those engaged in the design of reciprocating machinery, the following tables and diagrams have been prepared.

There are given the two proofs, usually found in text books, for the expression of the relative velocity of the crank-driven crosshead or piston when the velocity of the crankpin is taken as unity and constant; also the two usual proofs for the ratio of the tangential pressure on the crankpin to the momentary load on the piston. The crank angle which should always be the independent variable is called "theta" and the displacement of the piston or crosshead from its inner dead

* Consulting engineer to American-Krupp System Diesel Engine Company, New York.

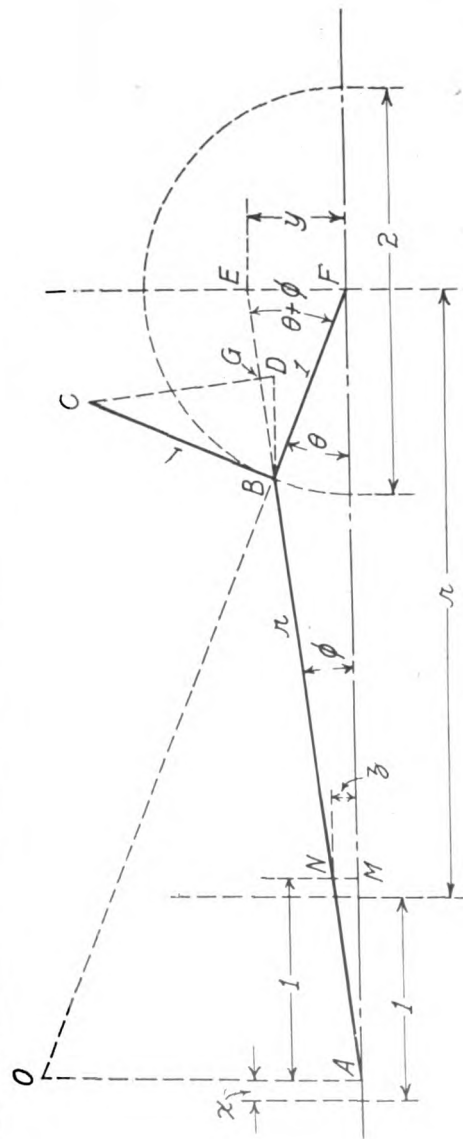


Fig. 1

Velocity of crankpin (BC) taken as unity = crank radius (BF).
 Velocity of crosshead : velocity of crankpin :: OA : OB :: EF : BF :: y : l.
 Triangle CBD = triangle BEF.
 BG = projection of BD on AE = projection of BC.
 BD = crosshead velocity if BC = crankpin velocity.
 Piston load (AM) taken as equal to unity.

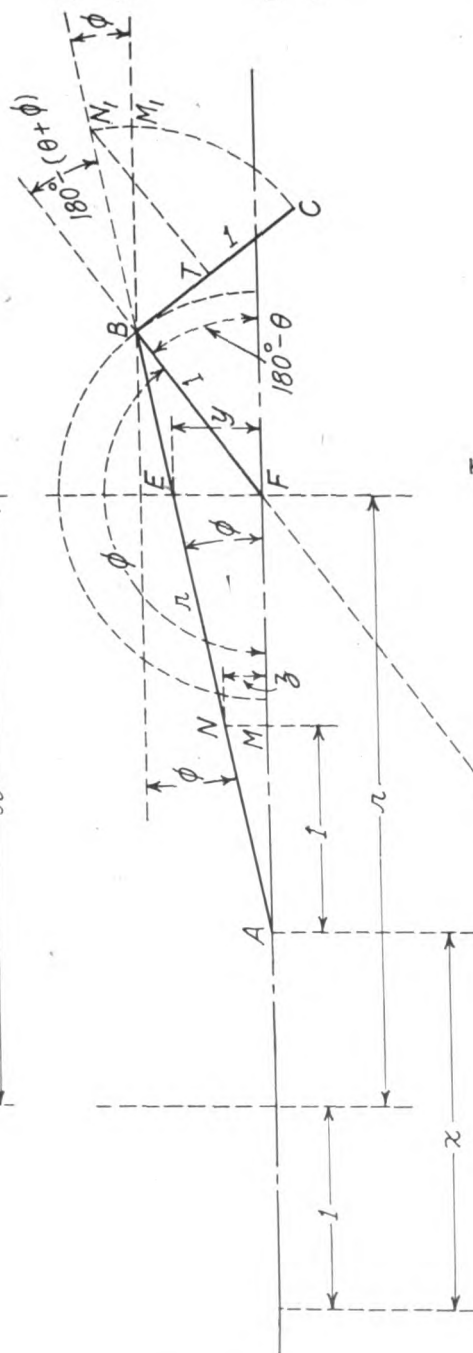


Fig. 2

BF : EF :: sin BEF : sin EBF :: cos phi : sin (theta + phi).
 Therefore

$$EF = BF \times \sin (\theta + \phi) \div \cos \phi = \frac{\sin (\theta + \phi)}{\cos \phi}.$$

Crosshead thrust : piston load :: NM : AM :: z : l.

Piston velocity X piston load = crankpin velocity X crankpin load = y.

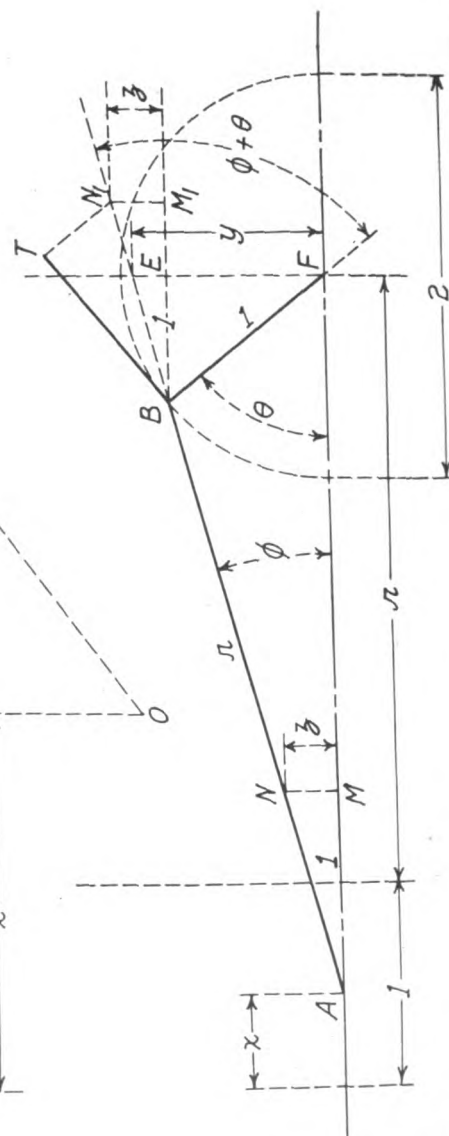


Fig. 3

BM₁ = AM taken = piston load.

Then BN₁ = connecting rod thrust,

and BT = tangential thrust on crankpin.

But BT = BN₁ X sin (theta + phi),

and BN₁ = BM₁ ÷ cos phi.

Hence

$$BT = \frac{\sin (\theta + \phi)}{\cos \phi} = EF = y.$$

TABLE I.—PISTON DISPLACEMENT, VELOCITY AND ACCELERATION FOR VARIOUS RATIOS OF CONNECTING ROD TO CRANK, UNITY BEING THE VELOCITY OF THE CRANKPIN

Angle of Crank	r = 4.00			r = 4.25			r = 4.50			r = 4.75			r = 5.00			r = 6.00		
	$x = (r + 1) - (\cos \theta + \sqrt{r^2 - \sin^2 \theta})$	$y = \sin \theta + \frac{\sin \theta \cdot \cos \theta}{r}$	$z = \frac{\sin \theta}{r} - \frac{\sqrt{r^2 - \sin^2 \theta}}{\theta}$	$x = (r + 1) - (\cos \theta + \sqrt{r^2 - \sin^2 \theta})$	$y = \sin \theta + \frac{\sin \theta \cdot \cos \theta}{r}$	$z = \frac{\sin \theta}{r} - \frac{\sqrt{r^2 - \sin^2 \theta}}{\theta}$	$x = (r + 1) - (\cos \theta + \sqrt{r^2 - \sin^2 \theta})$	$y = \sin \theta + \frac{\sin \theta \cdot \cos \theta}{r}$	$z = \frac{\sin \theta}{r} - \frac{\sqrt{r^2 - \sin^2 \theta}}{\theta}$	$x = (r + 1) - (\cos \theta + \sqrt{r^2 - \sin^2 \theta})$	$y = \sin \theta + \frac{\sin \theta \cdot \cos \theta}{r}$	$z = \frac{\sin \theta}{r} - \frac{\sqrt{r^2 - \sin^2 \theta}}{\theta}$	$x = (r + 1) - (\cos \theta + \sqrt{r^2 - \sin^2 \theta})$	$y = \sin \theta + \frac{\sin \theta \cdot \cos \theta}{r}$	$z = \frac{\sin \theta}{r} - \frac{\sqrt{r^2 - \sin^2 \theta}}{\theta}$	$x = (r + 1) - (\cos \theta + \sqrt{r^2 - \sin^2 \theta})$	$y = \sin \theta + \frac{\sin \theta \cdot \cos \theta}{r}$	$z = \frac{\sin \theta}{r} - \frac{\sqrt{r^2 - \sin^2 \theta}}{\theta}$
0°	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000	.00000
5°	.00476	.10887	.02179	.00470	.10739	.02051	.00465	.10544	.01937	.00461	.10344	.01835	.00457	.10152	.01743	.00453	.09960	.01653
10°	.01896	.21644	.04345	.01874	.21392	.04089	.01856	.21168	.03862	.01837	.20967	.03658	.01821	.20787	.03475	.01805	.20618	.03295
15°	.04246	.32145	.06484	.04196	.31775	.06101	.04152	.31447	.05761	.04113	.31153	.05457	.04078	.30889	.05183	.04046	.30710	.04918
20°	.07496	.42266	.08582	.07409	.41789	.08074	.07332	.41365	.07622	.07264	.40986	.07219	.07212	.40645	.06866	.07006	.40457	.06710
25°	.11608	.51891	.10625	.11476	.51319	.09993	.11368	.50811	.09433	.11253	.50368	.08933	.11164	.49950	.08480	.10860	.49661	.08061
30°	.16535	.60911	.12599	.16349	.60260	.11847	.16184	.59682	.11180	.16036	.59167	.10855	.15893	.58707	.10500	.15624	.58242	.09604
35°	.22218	.68226	.14489	.21973	.67510	.13620	.21755	.66855	.12851	.21560	.66322	.12164	.21396	.65817	.11548	.20833	.65294	.09060
40°	.28594	.76751	.16281	.28285	.76000	.15300	.28010	.75334	.14432	.27765	.74741	.13658	.27545	.74206	.12963	.26849	.73733	.08575
45°	.35589	.83411	.17961	.35213	.82642	.16873	.34880	.81962	.15911	.34582	.81356	.15054	.34315	.80812	.14286	.33470	.80303	.08118
50°	.43125	.89147	.19512	.42682	.88383	.18325	.42290	.87709	.17275	.41939	.87108	.16341	.41694	.86570	.15504	.40632	.86079	.07661
55°	.51120	.93816	.20922	.50611	.93082	.19642	.50261	.92534	.18513	.49739	.92087	.17508	.49483	.91651	.14697	.48260	.91280	.07182
60°	.59488	.97691	.22176	.58917	.96009	.20844	.58412	.95408	.19612	.57961	.94939	.18341	.57657	.94492	.13830	.46933	.94089	.06682
65°	.68141	1.00462	.23263	.67514	.99555	.21827	.66959	.98920	.20562	.66522	.98437	.19437	.66291	.97920	.12966	.45623	.97489	.06180
70°	.76992	1.02235	.24169	.76317	1.01723	.22672	.75719	1.01272	.21353	.75186	1.00812	.20182	.74708	1.00314	.19135	.73202	.99893	.05675
75°	.85936	1.03033	.24855	.85240	1.02632	.23338	.84607	1.02281	.21977	.84043	1.01968	.20769	.83537	1.01689	.18689	.71944	.99591	.05153
80°	.94948	1.02842	.25492	.94203	1.02517	.23870	.93543	1.02375	.22428	.92946	1.02193	.21451	.92430	1.01969	.18370	.70773	.99371	.04625
85°	1.03888	1.01861	.26080	1.03125	1.01721	.24112	1.02450	1.02168	.22973	1.02046	1.01989	.21450	1.01309	1.01391	.20332	.69612	.99187	.04097
90°	1.12702	1.00000	.26515	1.11932	1.00000	.24209	1.11232	1.00000	.22792	1.10646	1.00000	.21535	1.10102	1.00000	.20412	.68392	.98903	.03570
95°	1.21319	.97378	.25715	1.20556	.97618	.23112	1.19881	.97641	.22701	1.19279	.97750	.21450	1.18740	.97847	.20332	.67152	.98152	.03043
100°	1.29677	.94078	.25402	1.28932	.94344	.22820	1.28273	.94586	.22428	1.27686	.94801	.21193	1.27159	.94992	.20090	.65902	.95591	.02516
105°	1.37720	.90152	.24855	1.37004	.90552	.22338	1.36371	.90864	.21977	1.35707	.91217	.20769	1.35201	.91497	.19689	.64708	.92371	.01990
110°	1.45327	.85703	.24169	1.44634	.86215	.21827	1.43923	.86496	.21553	1.43250	.86767	.20451	1.42702	.87025	.18630	.63446	.88546	.01463
115°	1.52635	.80800	.23263	1.51938	.81406	.21312	1.51232	.81696	.20562	1.50588	.82016	.20182	1.50044	.82341	.17586	.62173	.85173	.00930
120°	1.59488	.75515	.22176	1.58917	.76196	.20844	1.58412	.76797	.20182	1.57961	.77393	.19437	1.57557	.77809	.16630	.60906	.81730	.00397
125°	1.65835	.69915	.20922	1.65327	.70649	.19642	1.64876	.71297	.18513	1.64474	.71873	.17508	1.64113	.72390	.15607	.59676	.77401	.00000
130°	1.71682	.64062	.19512	1.71240	.64826	.18325	1.70847	.65500	.17275	1.70467	.66101	.16341	1.70182	.66639	.14697	.58446	.73071	.00000
135°	1.77010	.58011	.17961	1.76634	.58780	.16873	1.76301	.59460	.15911	1.76003	.60066	.15054	1.75736	.60609	.13830	.57294	.68732	.00000
140°	1.81803	.51507	.16281	1.81493	.52258	.15300	1.81210	.52923	.14432	1.80974	.53616	.13658	1.80737	.54248	.12966	.56057	.64473	.00000
145°	1.86049	.45489	.14489	1.85803	.46200	.13620	1.85586	.46831	.12851	1.85391	.47393	.12164	1.85216	.47898	.12486	.54863	.60204	.00000
150°	1.89740	.39089	.12599	1.89554	.39740	.11847	1.89389	.40318	.11180	1.89241	.40833	.10585	1.89109	.41296	.12050	.53690	.56057	.00000
155°	1.92870	.32632	.10625	1.92737	.33205	.09993	1.92620	.33712	.09433	1.92515	.34166	.08933	1.92420	.34574	.11548	.52546	.52837	.00000
160°	1.95434	.26138	.08582	1.95348	.26615	.08074	1.95271	.27039	.07622	1.95203	.27418	.07219	1.95141	.27759	.11548	.51446	.49491	.00000
165°	1.97431	.19619	.06484	1.97381	.19989	.06101	1.97338	.20317	.05761	1.97298	.20611	.05457	1.97263	.20875	.11548	.50397	.47491	.00000
170°	1.98858	.13338	.04345	1.98836	.13662	.03862	1.98816	.13952	.03457	1.98798	.14243	.03043	1.98783	.14543	.11548	.49406	.45489	.00000
175°	1.99714	.06544	.02179	1.99704	.06786	.01937	1.99699	.06987	.01835	1.99695	.07187	.01743	1.99683	.07387	.11548	.48446	.43571	.00000
180°	2.00000	.00000	.00000	2.00000	.00000	.00000	2.00000	.00000	.00000	2.00000	.00000	.00000	2.00000	.00000	.00000	.00000	.00000	.00000

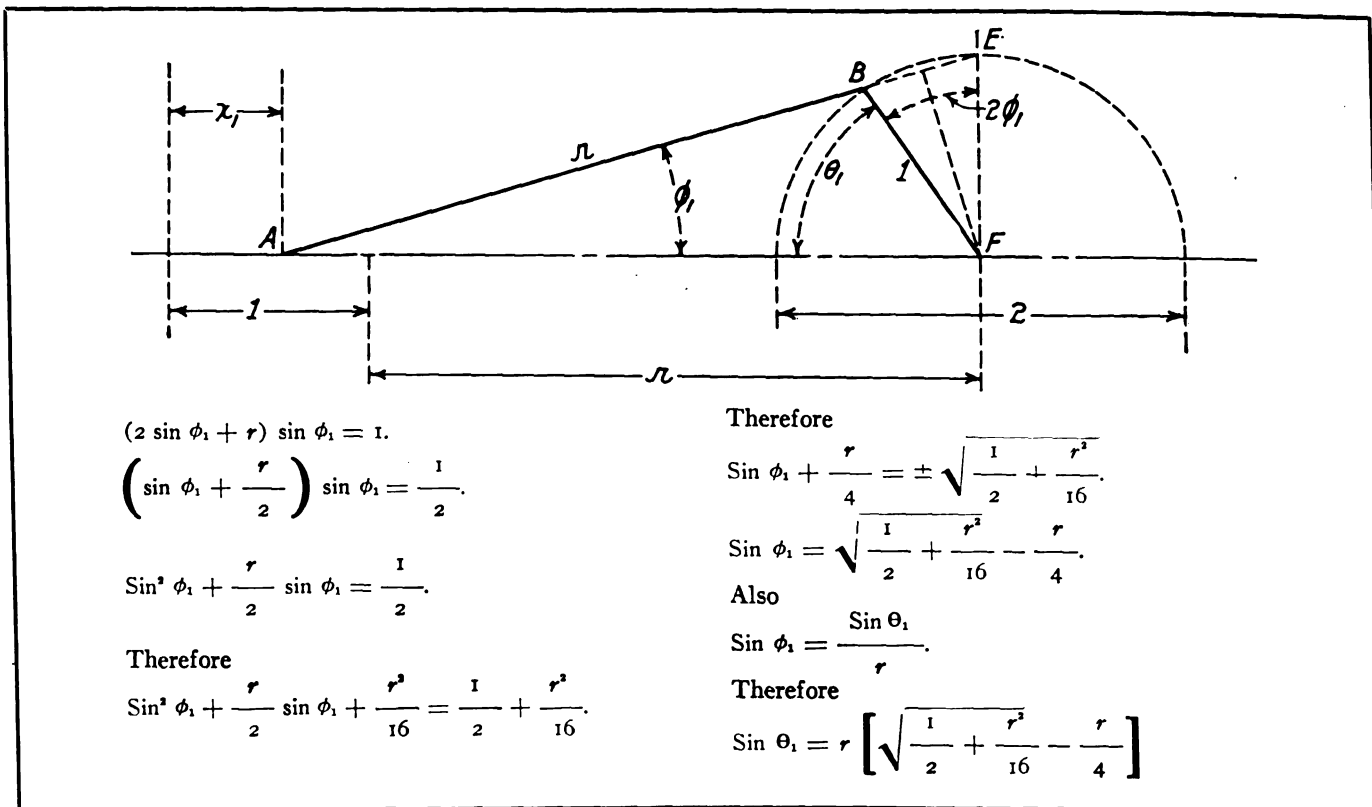


Fig. 4

TABLE II.—CRANK ANGLES AT WHICH VELOCITY OF PISTON EQUALS THAT OF CRANKPIN

$r = \text{Ratio of Connecting Rod to Crank}$	$\sin \theta_1 = r \left[\sqrt{\frac{1}{2} + \frac{r^2}{16}} - \frac{r}{4} \right]$	θ_1	$x_1 = (r + 1) - (\cos \theta_1 - \sqrt{r^2 - \sin^2 \theta_1})$	x_2	$y_2 = \text{max.}$	θ_2
$r = 4.00 \dots\dots$	.89898	$64^\circ, 01', 27''$	.66441	.89053	1.03088	$76^\circ, 43', 17''$
$r = 4.25 \dots\dots$	.90859	$65^\circ, 18', 41''$	.68057	.89546	1.02737	$77^\circ, 24', 07''$
$r = 4.50 \dots\dots$	.91696	$66^\circ, 29', 07''$	.69542	.90006	1.02445	$78^\circ, 01', 15''$
$r = 4.75 \dots\dots$	.92428	$67^\circ, 33', 36''$	.70908	.90434	1.02196	$78^\circ, 35', 08''$
$r = 5.00 \dots\dots$	.93070	$68^\circ, 32', 41''$	.72161	.90827	1.01983	$79^\circ, 05', 58''$
$r = 6.00 \dots\dots$	.949875	$71^\circ, 46', 56''$	.763035	.92145	1.01380	$80^\circ, 46', 32''$

point "x." With the length of the crank taken as unity, the stroke must be two and the path of the crankpin through 180 degrees will equal 3.1416. The velocity of the crosshead or piston is represented by "y," unity being the velocity of the crankpin.

Six different ratios of connecting rod length to crank length are presented, representing the ratios most common to general practice, and these ratios are designated by the letter "r."

For many years the problem of the maximum velocity of the piston, the velocity of the crankpin being taken as constant, was vouchsafed no accurate analytical solution, though graphical solutions have been published. Professor Hill's solution is perfectly satisfactory, but his work involves the use of a subsidiary angle. The maximum relative velocity of the piston to the crankpin is not of as much importance, either in quantity or position, as determining the exact position when the velocity of the piston first becomes equal to that of the crankpin.

It is easily seen that when the crank stands at right angles to the line of stroke, the velocity of the piston has decreased to become once more momentarily equal to that of the crankpin, and it is the angular distance in the first quadrant, from the position of the crank when the velocity of the piston first equals that of the crankpin to the 90-degree position, that should be taken into consideration in the design of valve operating mechanism.

It would seem as if the leading face of the admission valve

cam should be steeper than the back face, and, correspondingly, the slope of the leading face of the exhaust valve cam should be more gradual than its back face. This statement must be accepted with a proper allowance for the lag of the entering fluid, owing to its inertia and impedance due to the form and size of the valve and its passages.

In the case of the acceleration and retardation curves it is considered essential to draw in the cosine curve, because the crankpin box, together with its cap, bolts, nuts and the flange by which the box is secured to the connecting rod, are accelerated and retarded strictly in accordance with this cosine curve. The acceleration and retardation of the shaft or rod proper of the connecting rod lies not quite midway between the cosine curve and the curve of piston and crosshead acceleration and retardation. The wristpin box or boxes, together with caps, bolts and attaching flanges at the crosshead end of the connecting rod, accelerate and retard at the same rate as the piston, piston rod, crosshead and all other reciprocating masses, including the cooling water, if there is any, as in the case of a Diesel engine.

It has not been considered necessary or desirable, however, to attempt to set down the ordinates of the cosine curve, sine curve or 1-cosine curve, since these are readily obtained from any table of natural angular functions.

It is hoped that designing draftsmen will find herein substantial aids to the solution of some of the many problems they are called upon to deal with.

CURVES OF PISTON DISPLACEMENT, VELOCITY AND ACCELERATION

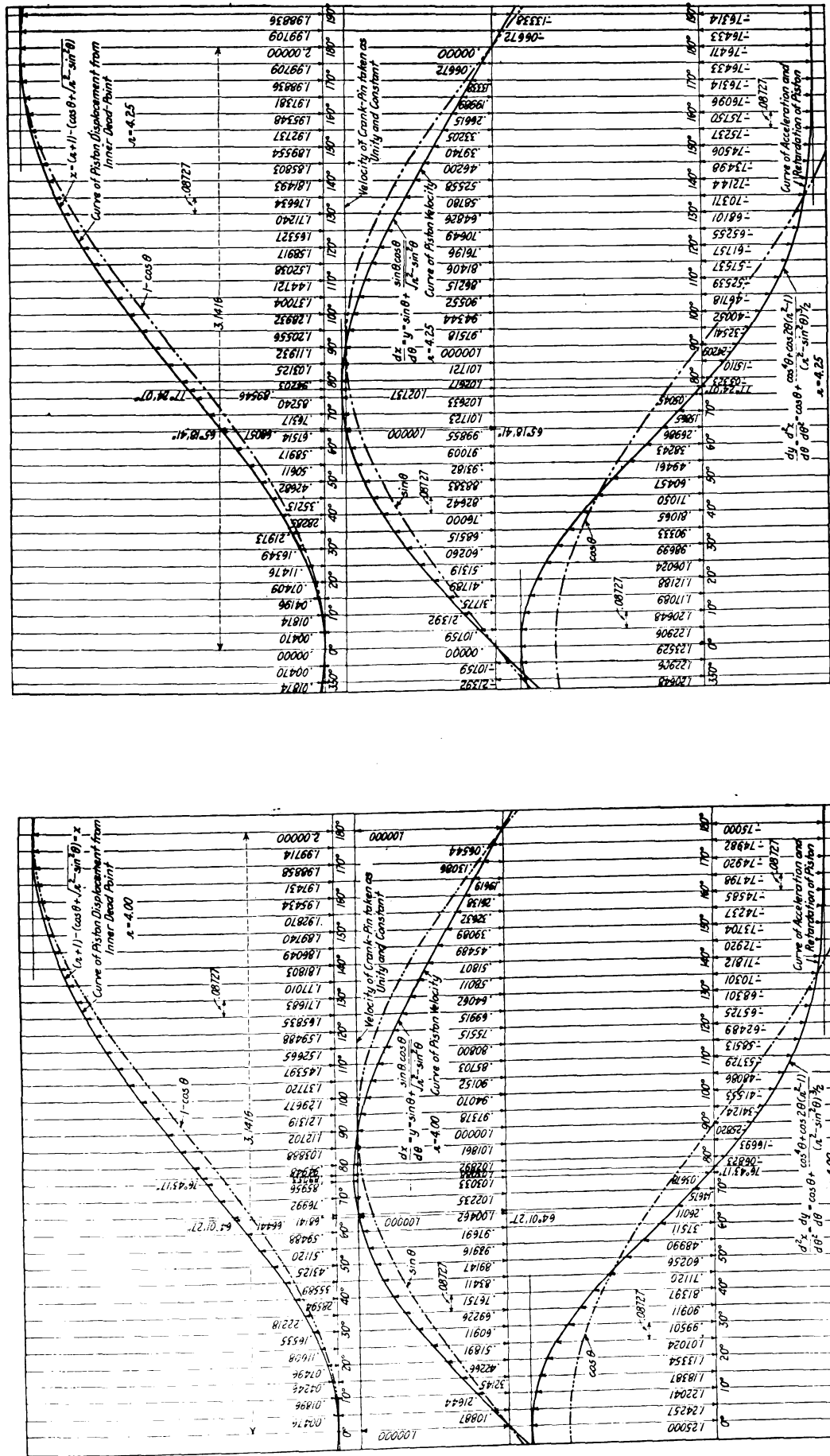


Fig. 5.—Ratio of Connecting Rod to Crank = 4.00

Fig. 6.—Ratio of Connecting Rod to Crank = 4.25

CURVES OF PISTON DISPLACEMENT, VELOCITY AND ACCELERATION

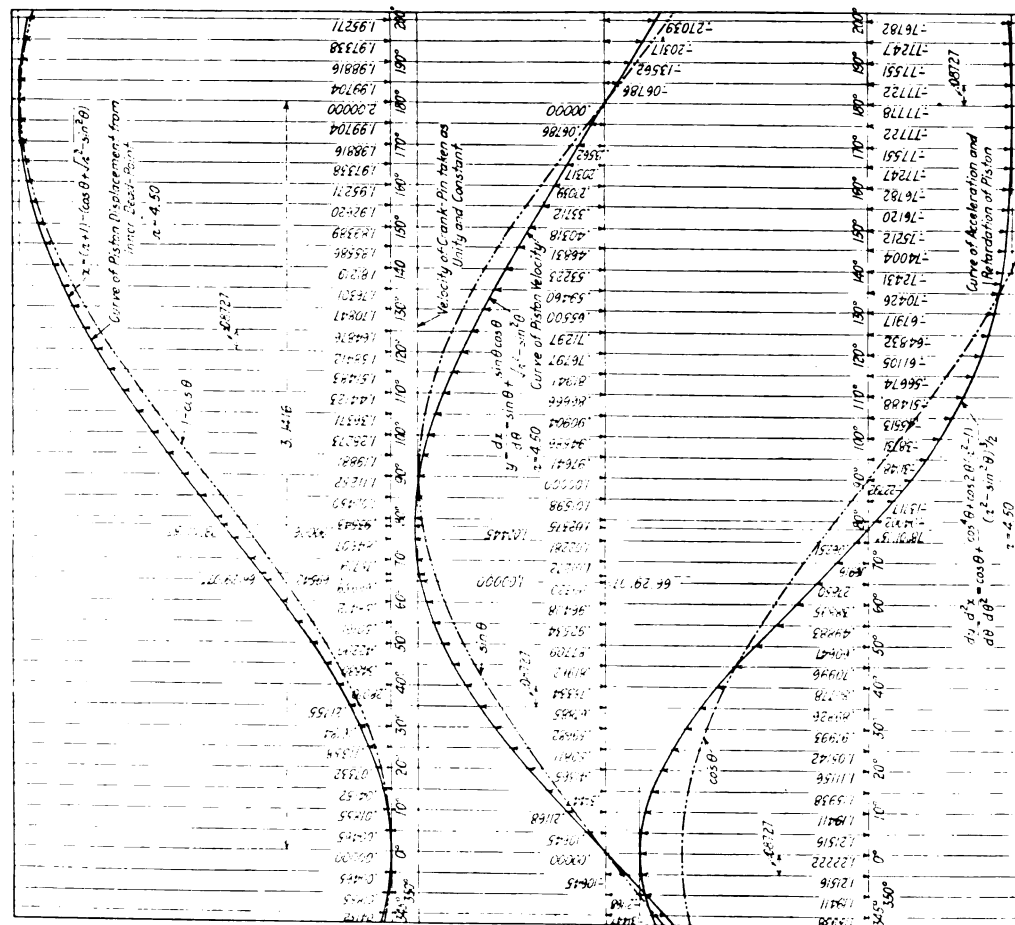


Fig. 7.—Ratio of Connecting Rod to Crank = 4.50

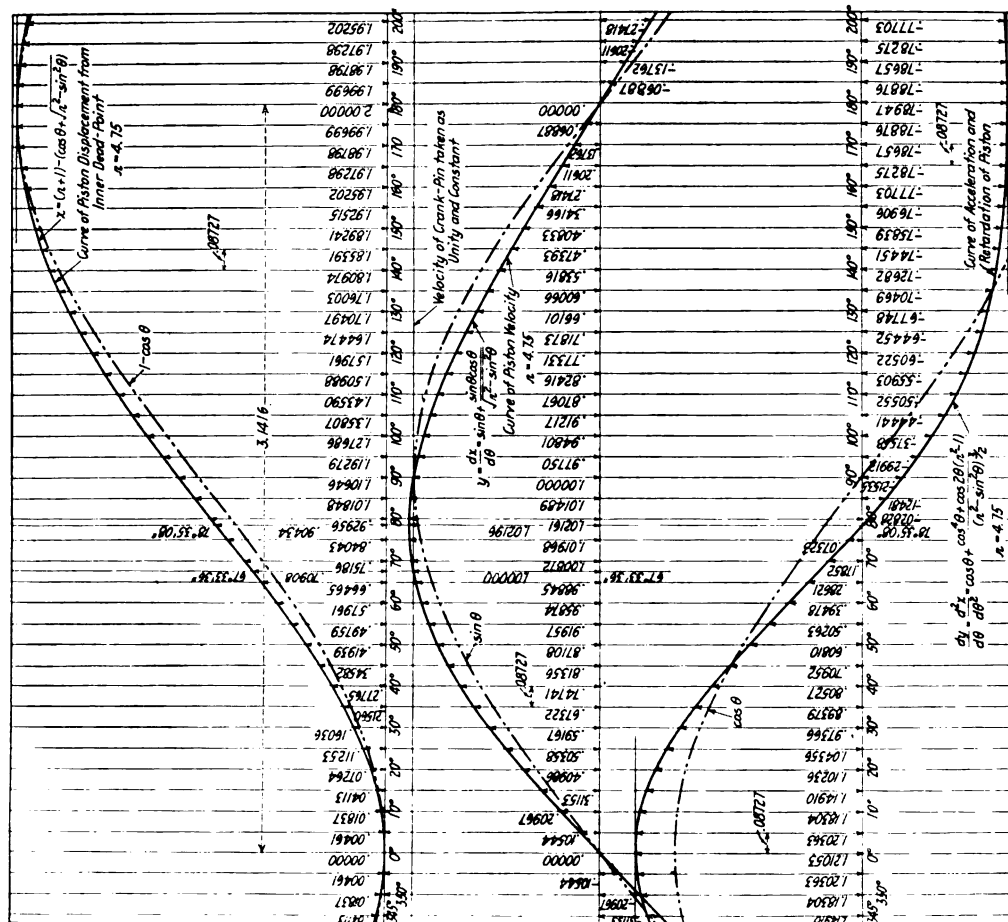


Fig. 8.—Ratio of Connecting Rod to Crank = 4.75

CURVES OF PISTON DISPLACEMENT, VELOCITY AND ACCELERATION

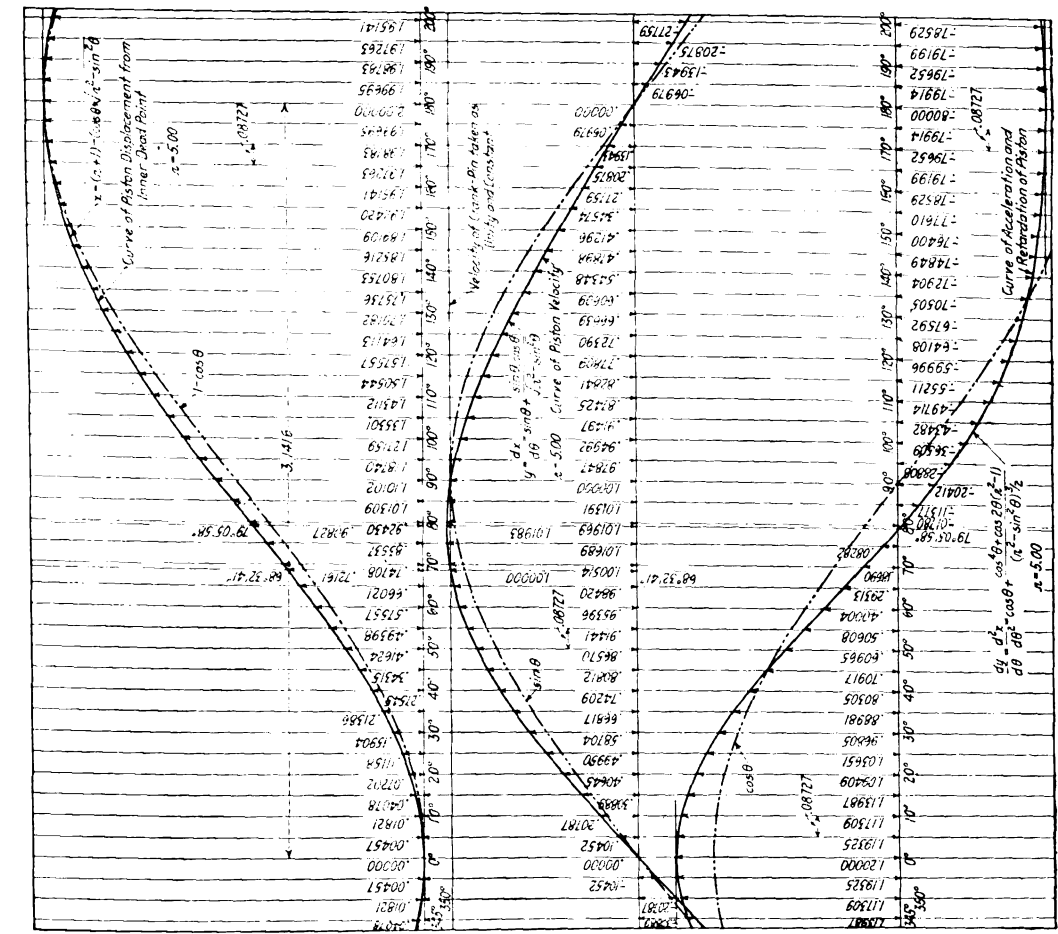


Fig. 9.—Ratio of Connecting Rod to Crank = 5.00

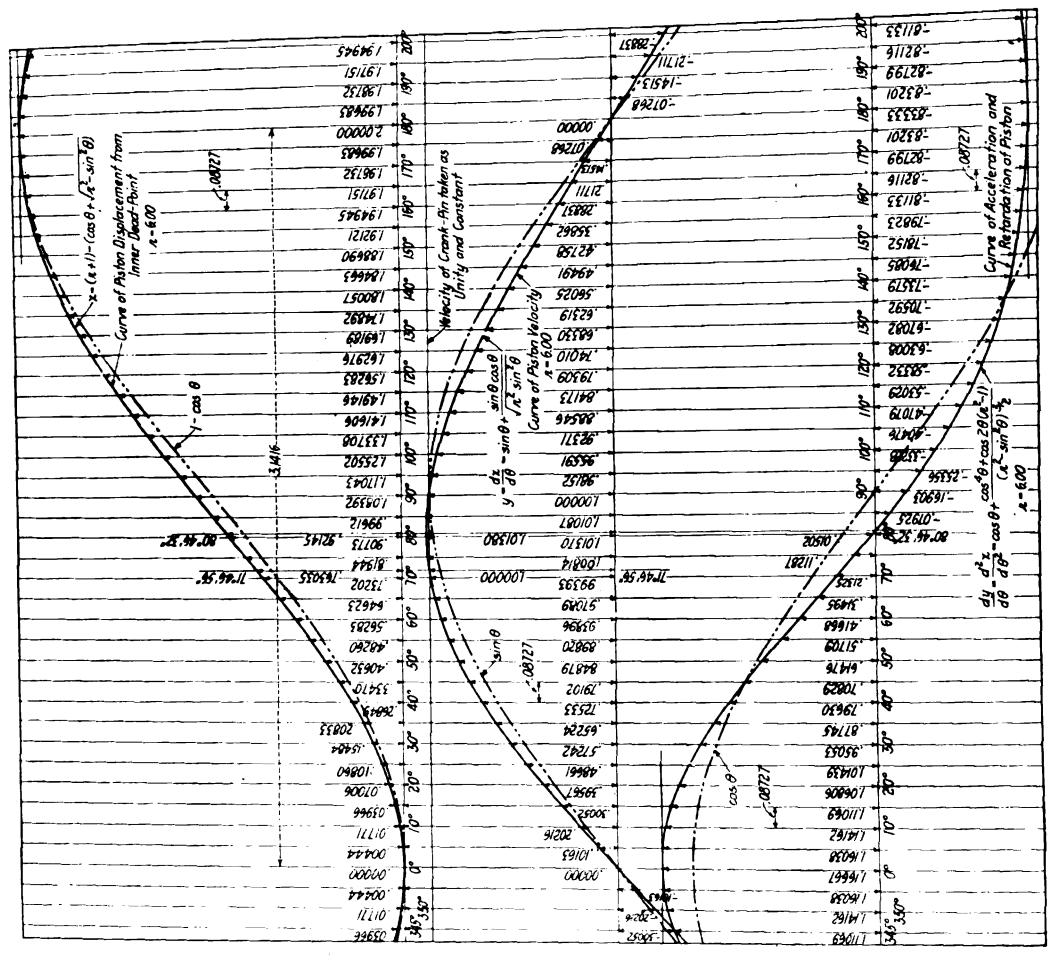


Fig. 10.—Ratio of Connecting Rod to Crank = 6.00

Economical Cargo Ships—Model Experiments*

Results of Model Experiments to Determine the Best Form for Propulsion of Full Cargo Ships

BY ALFRED J. C. ROBERTSON

THE type of lines suitable for vessels of slow and moderate speeds and of full form has received much attention of late years at the various experimental model basins, and special mention is due to the very thorough series of tests made at the Froude National Tank, London, and reported through the Institution of Naval Architects by Messrs. G. S. Baker and J. L. Kent in several recent years and to

have shown that the location of the parallel body forward of amidships has diminished the resistance of the model and also increased the efficiency of propulsion.

This paper covers somewhat similar ground for vessels of several prismatic coefficients exceeding .70, covering the field somewhat more fully and also supplying some further information regarding the form of areas curve associated with minimum resistance.

The experiments about to be described were conducted in two series independent of one another. The first set, designated Model 1107, consisted in the modification of the curve of areas of the afterbody (both in its area and in its curvature) of a successful cargo ship of high prismatic coefficient. The second set, based on Model 1130, was more extensive and consisted in the development of several entrances and runs each of identical form as to cross-section and curve of areas but of varying length combined with various lengths of parallel middle body, and these various fore and after bodies so united as to secure two or three models each of identical dimensions, draft and prismatic coefficient but with the position of the parallel middle body varied. These experiments were all carried out for the Emergency Fleet Corporation, and it is by their courtesy that they have been made available for publication today.

A tabulation of the particulars of both sets of models is presented herewith:

PARTICULARS OF MODELS

DESIGN 1107

Displacement Length, 400 Feet; Breadth, 53.66 Feet; Draft, 23.85 Feet; Tested at Draft Ratio of .438

Type	Percentage Parallel Body	Prismatic Coefficient	L.C.B. from Amidships, Percent
Forebody	25.0	.837	42.47
Afterbody—			
A	23.7	.817	41.63
AX	15	.758	39.51
B	15	.790	40.51
BX	9.6	.758	39.33
C	15	.790	40.83
CX	9.6	.758	39.68

DESIGN 1130

Displacement Length, 400 Feet; Breadth, 52.70 Feet; Draft, 23.29 Feet; Tested at Draft Ratio of .435

Type	Percentage Parallel Body	Prismatic Coefficient	L.C.B. from Amidships, Percent
Forebody—			
B	5.84	.709	37.8
C	10.95	.743	38.9
D	16.7	.776	40.1
E	21.19	.810	41.4
F	26.31	.844	42.8
G	31.42	.878	46.3
Afterbody—			
V	4.56	.690	37.2
W	9.5	.724	38.2
X	14.45	.758	39.4
Y	19.38	.791	40.6

The above percentages for position of longitudinal center of buoyancy are based on half length of ship, each type listed being one-half length of vessel. For convenience the parallel body is expressed as a percentage of the full length of the ship.

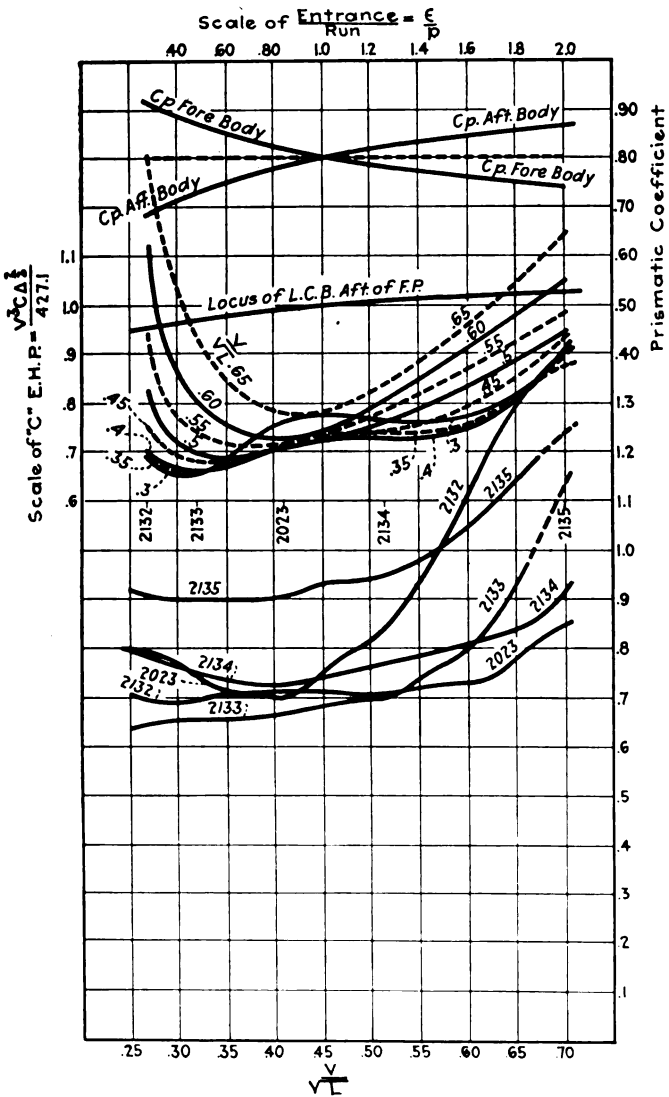


Fig. 1

Mr. McEntee's recent papers presented to the Society of Naval Architects and Marine Engineers, as well as to the earlier contributions to our knowledge of the subject made by Admiral Taylor, Dr. Sadler and other investigators.

In results of full form Admiral Taylor has shown that a certain amount of parallel middle body is necessary to produce minimum resistance, and Messrs. Baker and Kent have supplied the results of tank tests of vessels with 10 percent, 30 percent and 50 percent parallel body located amidships.

Mr. McEntee's recent papers, confirmed by Mr. Sample,

* Paper read before the Society of Naval Architects and Marine Engineers, New York, November 11, 1920.

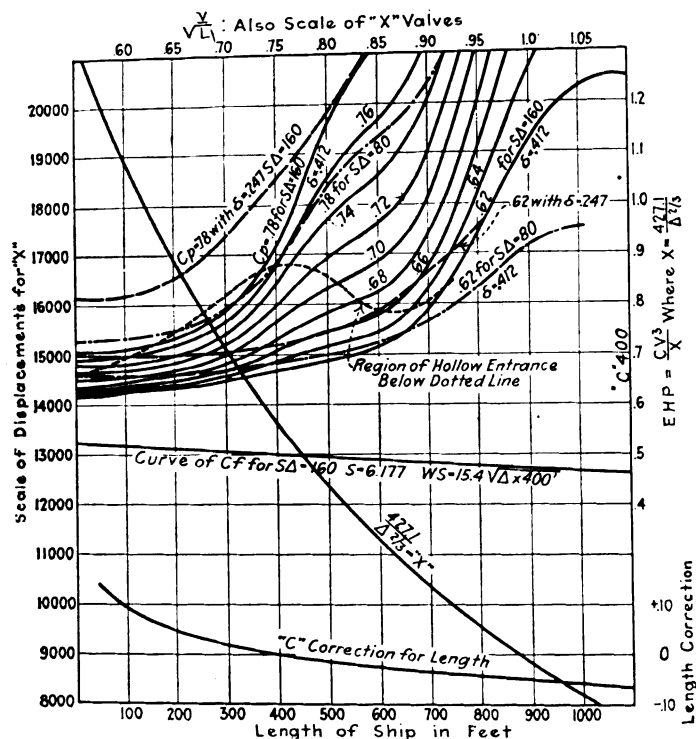


Fig. 2

METHOD OF EXPERIMENT

These tank tests were, in almost every case, carried out at the University of Michigan experimental tank because models used in that tank are of wax and variations in such models are much more readily accomplished and at a much lower cost than is possible with the larger wood models in Washington. At the same time one single screw model was tested at Washington in order to link up the Ann Arbor and Washington tests, and the twin screw model, with and without bossing, was tested in Washington.

It should be noted that the method of extension of experimental model tank tests at Ann Arbor is based on the coefficients of Tideman both for the model and the full-sized ship. These apparently coincide with the results of tests made at the tank some time ago on the frictional resistance of plane surfaces. At the same time it must be pointed out that Tideman's formulae for skin friction, when applied to the full-sized ship, give resistance considerably higher than those attained by the use of the Froude coefficients in the region of speed of cargo ships such as are now under consideration.

METHOD OF PRESENTATION

All the results are presented herewith in the form of C constant curves for a length of 400 feet, wherein

$$C = \frac{427.1 \times E.H.P.}{V^3 \times \Delta^{2/3}}$$

and

$$E.H.P. = \frac{C \times V^3 \times \Delta^{2/3}}{427.1}$$

This is somewhat of an innovation on this side of the Atlantic, but the advantages of this form of presentation appear to the writer to be so important that he considers it well worth while to draw attention to this system. It should be

noted, however, that the speed ratio $\frac{V}{\sqrt{L}}$ used in this paper is the one familiar to our designers, where V equals the speed

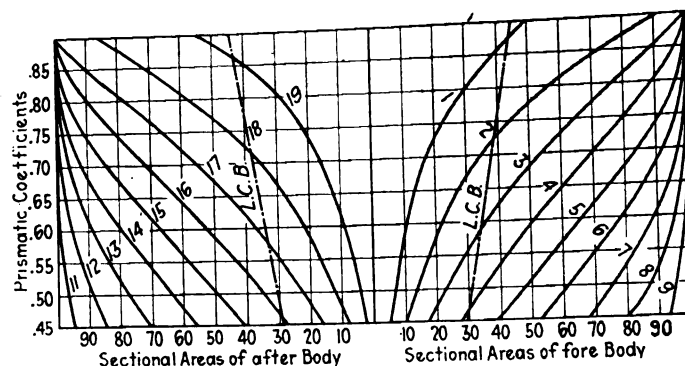


Fig. 3

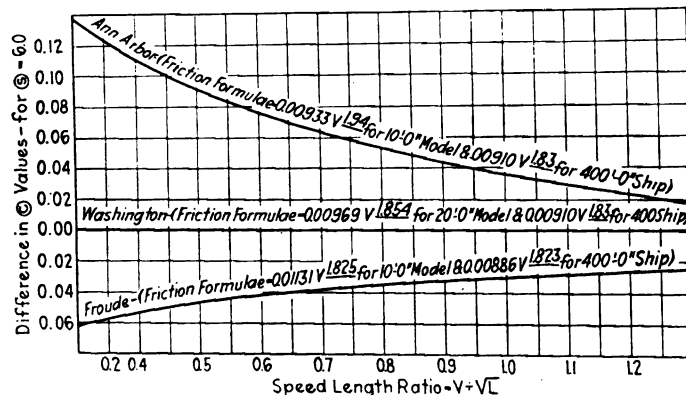


Fig. 4

in knots and L is equal to the actual displacement length of the ship. No use has been made of the speed constant P used largely by Messrs. Baker and Kent because curves on that basis are not so readily comparable for estimating purposes and also because the writer has failed to detect any corroboration of Messrs. Baker and Kent's theory regarding humps and hollows of resistance in the models whose results are presented to you today. It is probable that the theory advanced, that at certain fixed P values resistances are at a maximum, may not hold good where the variation in prismatic coefficient is procured by variation in ratio of entrance to run in conjunction with variation of parallel middle body or possibly the speeds of these ships were too low to prevent the masking of Baker's humps by other more important developments of resistance. I believe that the curves presented in this paper would permit some investigation along these lines.

In order to illustrate this form of presentation and to permit of ready comparison of present results with previous investigations, diagrams of tests showing the effect of location of parallel middle body as carried out by Mr. McEntee and published a couple of years ago are shown on Fig. 1. Fig. 2 gives Taylor's standard series plotted as C curves for 400 feet length, together with C correction curves for other

lengths, and a curve of $\frac{427.1}{\Delta^{2/3}}$ designated X , by means of

which the effective horsepower may be immediately arrived at from one diagram. Areas of the various sections at different prismatic coefficients for Taylor's series are shown on Fig. 3 in order that the form of Taylor's models may more readily be compared with the series here presented.

In addition a diagram, Fig. 4, is presented showing the theoretical difference between tank tests as extended by the various coefficients of friction now in use at Ann Arbor, Washington and in England. These curves are based on the assumption that the actual friction of a model of unit length at the three tanks is identical, but careful comparisons between tests of the same model made at Ann Arbor and at

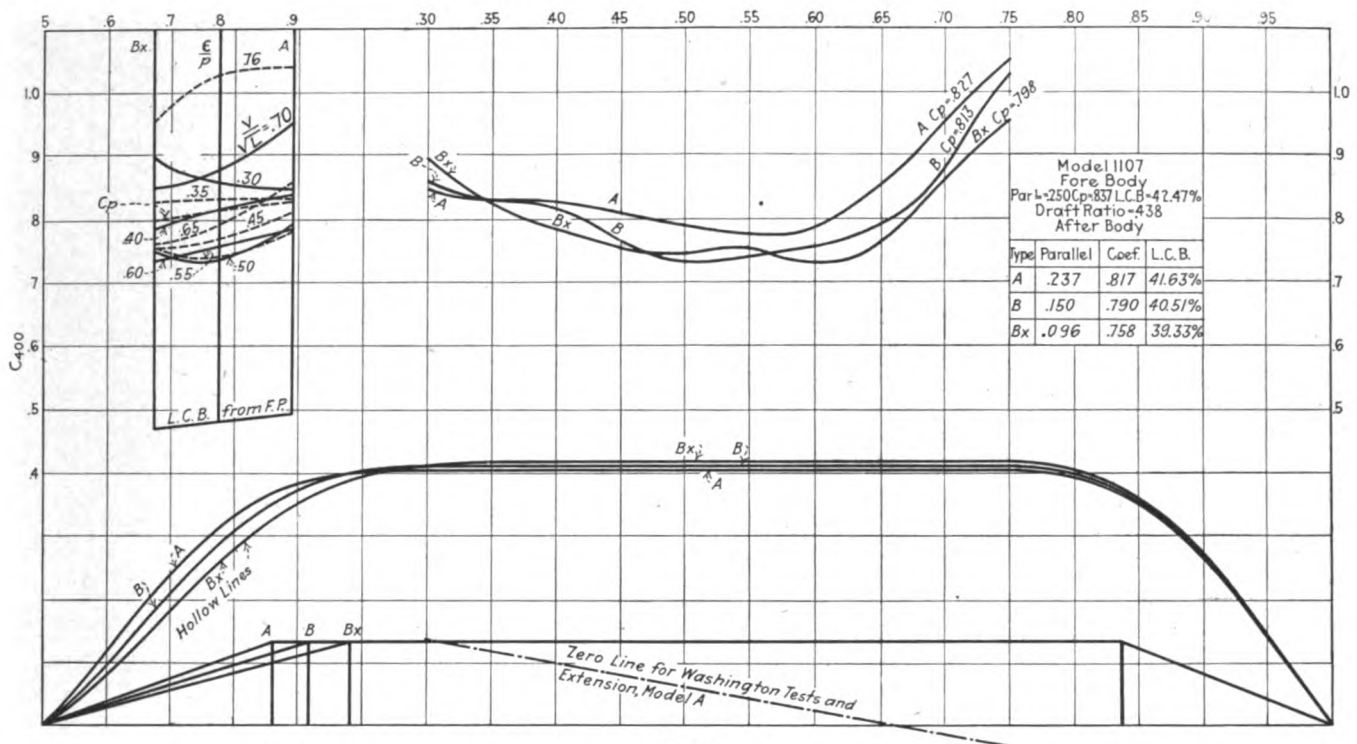


Fig. 5

Washington seem to indicate that the Washington resistances, particularly for models of high displacement, run somewhat higher than can be anticipated from these curves. Whether this is due to some interference in the stream lines, due to the cross-section of the Washington model being larger in proportion to the section of the tank than is the case at Ann Arbor, or whether it is due to elements of eddy making not yet properly understood or simply to the actual difference in the surface of the models is yet unknown to the writer.

Because of the uncertainty of what is the true frictional resistance of these models the method adopted at Ann Arbor of using Tideman's coefficients has been accepted for use by the writer in extending present results and we thus secure very conservative resistances.

That the Ann Arbor estimates of effective horsepower for

slow speed cargo steamers appear to be very close to the actual effective horsepower required for the ship has been demonstrated in quite a large number of cases and I think this might be explained by Baker's theory of the augmentation of frictional resistance in full ships due to the nature of the wave profile and the resultant acceleration of velocity of the water at the surface of the vessel, the magnitude of this increase in resistance being roughly equal to the difference between effective horsepowers calculated by Froude's method and effective horsepowers calculated by the Tideman formulæ. I have not been able to ascertain whether Baker has applied this correction to his model resistances as recommended in his book* before compiling his C constants given in his recent papers.

* "Ship Form, Resistance, and Screw Propulsion," paragraph 10.

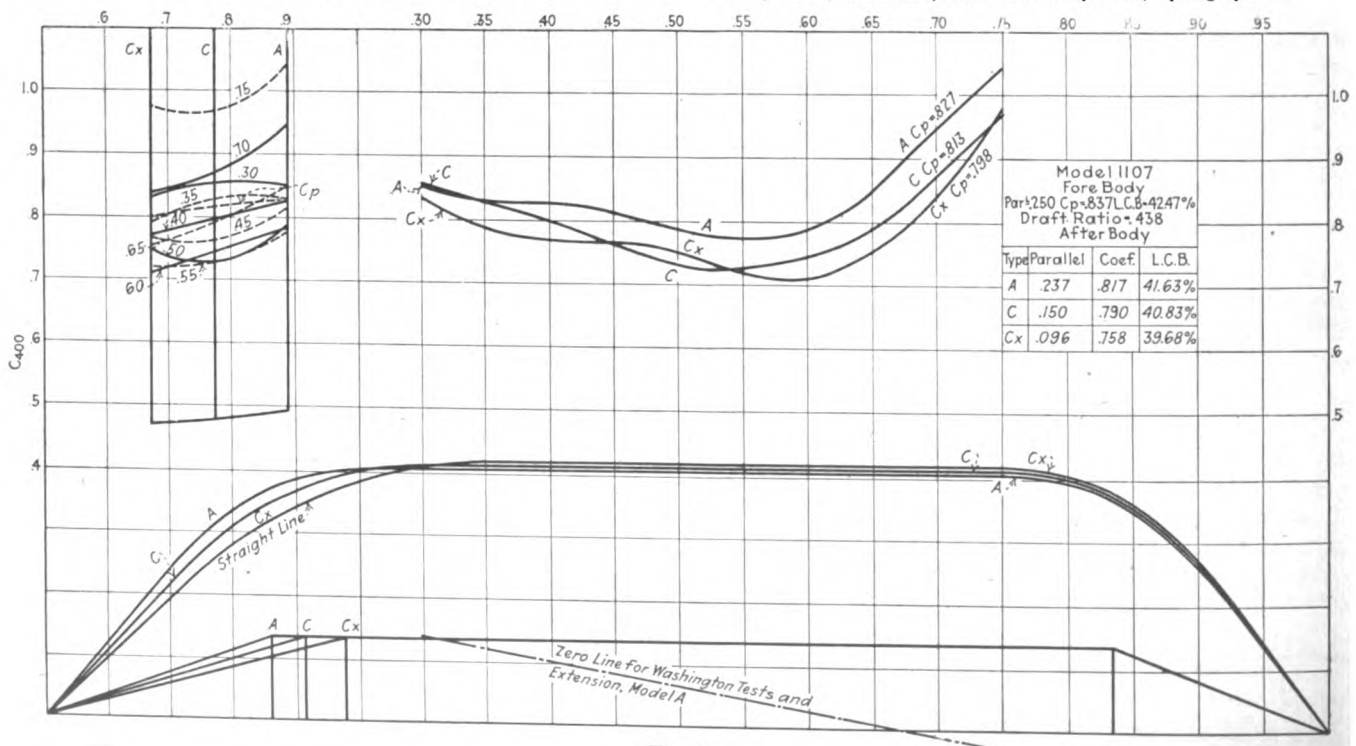


Fig. 6

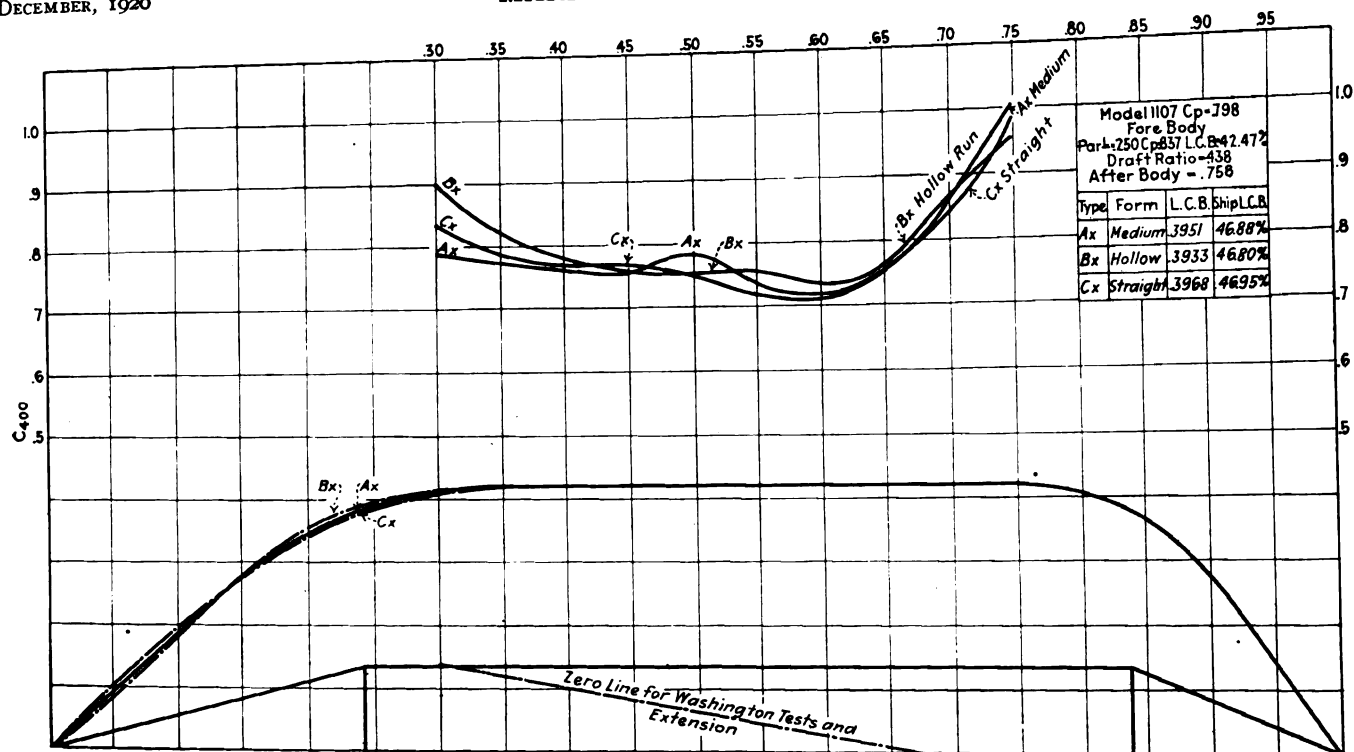


Fig. 7

All results given herewith have been standardized for a water temperature of 70 degrees F.

Those who have prepared the lines of vessels with parallel body will recognize that it is difficult to state definitely the point where entrance and parallel body combine and that this point may be varied very considerably with an extremely small variation in the form of the ship. For this reason it was found necessary, in order to make comparisons fair, that an analysis length of entrance and run should be devised. At the same time it has been demonstrated repeatedly that the form of midship section within the range adopted in cargo ships does not make any material difference in the resistance of the ship, and as it was necessary to standardize draft as well as form, the following method was employed. A slight modification of the block model, generally known as Dr. Kirk's analysis, was adopted wherein the breadth of the model was maintained equal to the breadth of the ship and modification was made in the draft, this being such that the cross-sectional area of the model is the same as the midship section of the ship. This gives us an analysis draft equal to the product of draft of the vessel and coefficient of midship sectional area, and the angles of entrance and run are such that the plan of the block model contains exactly the same area as a curve of sectional areas of the ship. The fraction of the length of the vessel which would consist of entrance is equal to 1 minus prismatic coefficient of fore body. The fraction of the length of the vessel represented by parallel middle body is equal to twice the prismatic coefficient of the whole ship minus 1 and the fraction of length of run is, of course, equal to 1 minus prismatic coefficient of after body. This block model, which is bounded by straight lines and contains a volume equal to the displacement of the ship, indicates the mean angle of entrance and mean angle of run of the vessel as well as the analysis length of entrance and run; examples are shown on Figs. 5, 6, 7 and 9.

In order to distinguish this analysis entrance from the ordinary length of entrance the Greek letter ϵ has been used and for run the letter ρ has been adopted, the parallel middle body being represented by π and the ratio of entrance to run has been expressed as ϵ/ρ throughout the paper. The analysis draft when divided by breadth gives the analysis draft ratio δ . (See Appendix I.)

SERIES 1107

Model 1107 is that of an ordinary cargo ship with plumb stem and counter stern raised well above the load waterline and the length for displacement was taken as 98 percent of the length between perpendiculars. The original model designated A had a curve of areas as shown in the lower part of Figs. 5 and 6 and was tested both at Washington and at Ann Arbor. The Ann Arbor model was then finned in two steps as shown, the resulting resistance curves being also shown. Cross curves of C values at different speeds are given in the left hand end of each diagram plotted on ϵ/ρ ratios, and a zero line which required a certain amount of fairing has been shown indicating the actual difference in C value for model A as tested and extended at Washington and at Ann Arbor. In Fig. 6 the two modifications designated C and CX are identical with B and BX in Fig. 5 as regards prismatic coefficient, but are straight in form and consequently easier at the after shoulder than the B curves. It will be noticed that the straight form generally produces the lower resistances but has not eliminated a curious crossing in the C curves around the region of a speed ratio of 0.50.

A third comparison of resistances is shown in Fig. 7, BX and CX being plotted together with an intermediate curve identical in form with the original curve of areas A, but of the same prismatic coefficient as BX and CX. Special attention must be drawn to the development of the hump in these three

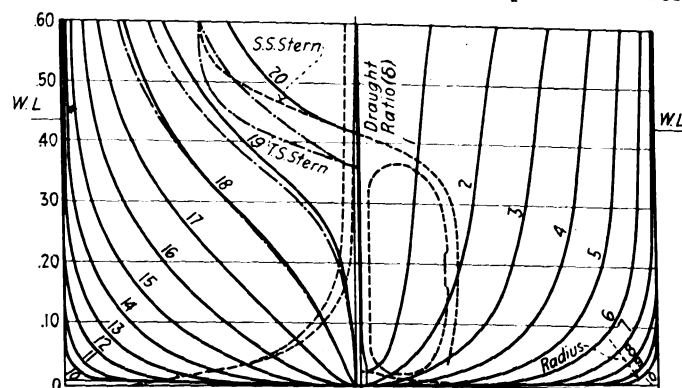
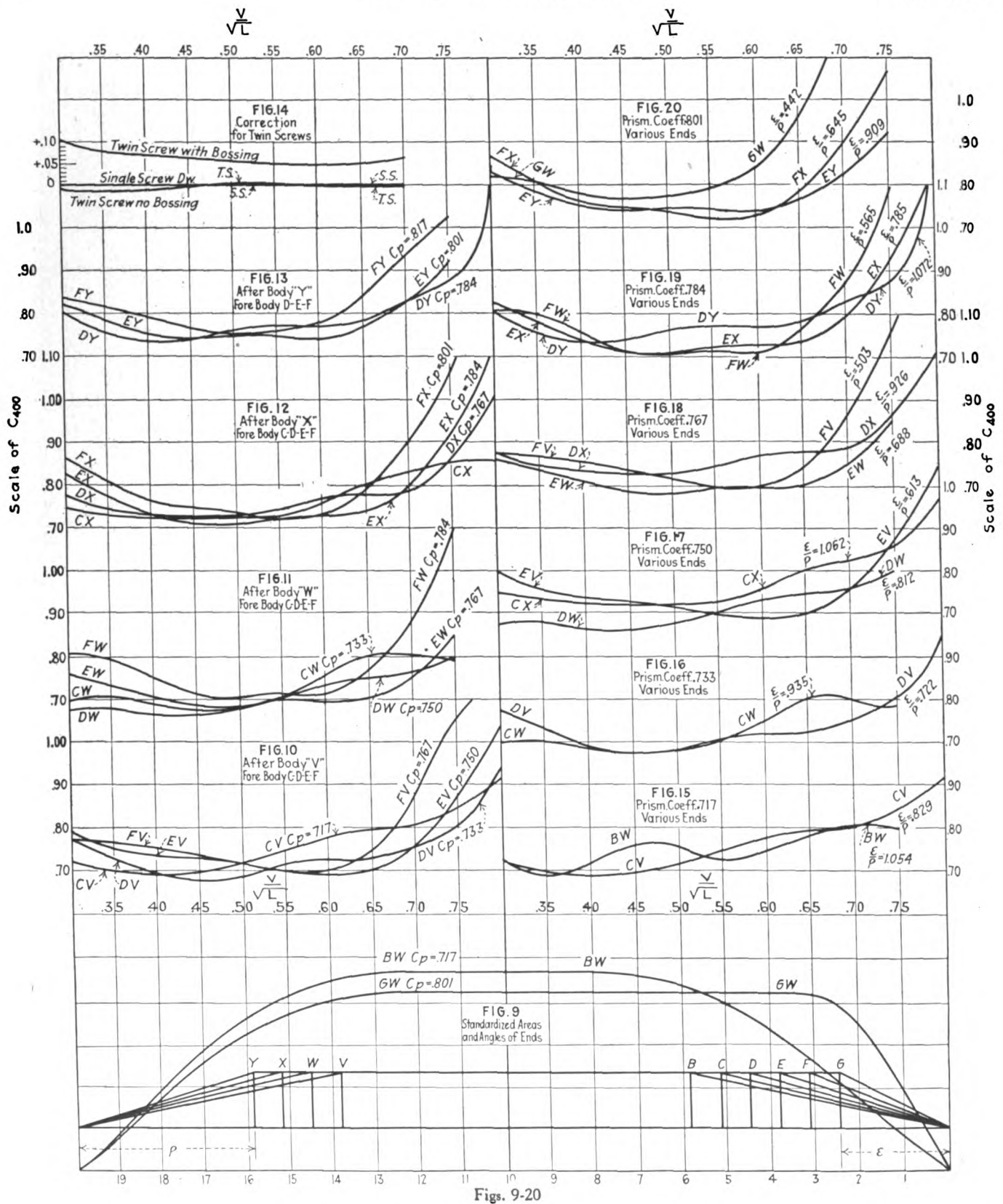


Fig. 8



Figs. 9-20

models, all of identical prismatic coefficients, and the emphatic increase in resistance which AX shows compared with BX and CX at a speed corresponding to 10 knots for a 400-foot ship cannot be lost sight of because this illustrates a danger to which naval architects are exposed in departing from known models from which resistances are estimated.

SERIES 1130

Series 1130 represents a model of a single screw cargo ship as shown on Fig. 8, which gives cross-sections of the entrance

and run, the parallel body being omitted. This model has a very small cruiser stern which, at the draft reported herewith, was only sufficient to carry the lines and curve of areas to the aft perpendicular. Generally the aperture in a single screw steamer makes the displacement length 2 percent or 3 percent less than the length between perpendiculars. In this series the various combinations of entrance and run produced in all 18 models for the single screw type, and there was a twin screw model of DW modified, both with and without bossing. The twin screw model was tested at Wash-

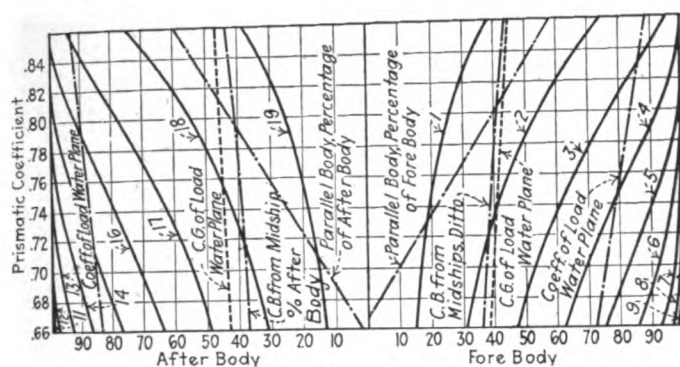


Fig. 21

ington only and the *DW* was tested both at Washington and Ann Arbor. All these models were tested at draft ratios of 0.489, 0.435, 0.351, 0.261, with the exception of the twin screw model, where the displacements were held identical and the draft ratio was therefore very slightly reduced, but in order to keep this paper within reasonable compass the results at $\delta = 0.435$ only are presented herewith.

Fig. 9 indicates the angles of entrance and run corresponding to these models, and standard curves of areas of the two

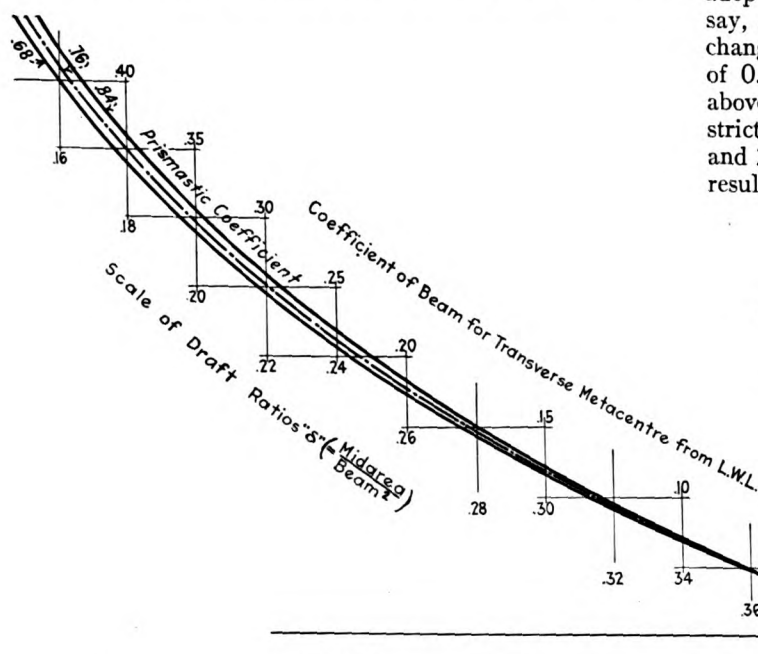


Fig. 22

extremes of the *W* series are shown. These standard curves of areas are plotted in such a way that the actual area of curve in each case is identical, thus indicating in what part of the ship the displacement is carried. For this purpose the midship area is laid out equal to 100 divided by three times the prismatic coefficient. In Figs. 10, 11, 12 and 13 these resistance curves are presented where each after body is shown with three or four different fore bodies, one or two curves having been left out of some of the diagrams to prevent confusion. Resistance curves could equally well be assembled with identical fore body and varying after body, and the student will find advantage in laying them out this way.

In Figs. 15 to 20 the curves of resistance shown in Figs. 8 to 11 are assembled in accordance with the prismatic coefficient, and these curves will probably prove of more use to anyone desiring to utilize this series of experiments for design purposes. Cross curves of each of these diagrams can also be plotted similar to those shown in Figs. 4 and 5, and if this is done it becomes a simple matter to select the best ϵ/ρ ratio for any particular speed.

Fig. 14 shows the comparison between single screw vessels and a ship of similar lines to *DW* with the aperture filled in as indicated by the dotted lines on Fig. 8, and the resistance of the twin screw bossing for this model is also given as indicating the augmentation of resistance which is produced on twin screw ships.

In order to fully utilize these results in the design of a cargo ship, Fig. 21 was prepared. This diagram is laid off on prismatic coefficients, both for fore body and after body, which are independent of one another, and when the necessary prismatic coefficient of each end is chosen from one of the figures (15 to 20) it is immediately possible to lay off a curve of areas for the prismatic coefficient of each end from Fig. 21. The amount of parallel middle body is also shown so that the entrance and run may be divided up equally and the sections made to correspond to Fig. 8. As it is necessary, usually, in designing a ship to have a fairly accurate knowledge of the height of transverse metacenter at an early stage of the work, a new diagram, Fig. 22, has been devised by the writer. It gives the location of the transverse metacenter from the load waterline as a coefficient of the beam of the ship at various draft ratios and at three prismatic coefficients, but it is noteworthy that the prismatic coefficient has an extremely small influence on the stability at draft ratios such as are adopted in ordinary merchant ships. For example, a ship of, say, 50-foot beam at a draft of 19 feet 6 inches shows no change in metacentric height between the prismatic coefficients of 0.68 and 0.84, the metacenter being about 16½ inches above the load waterline in each case. This diagram is strictly true, of course, only for ships of form given in Figs. 8 and 21, but it will be found that it gives reasonably accurate results for any ship within the range of coefficients covered.

APPENDIX I

LIST OF SYMBOLS EMPLOYED IN PAPER

C_m	= midship area coefficient, i. e.,	Mid area
		Breadth $\times$ Draft
C_p	= prismatic coefficient, i. e.,	Displacement in cubic feet
		Length $\times$ mid area

$$C = \text{Froude's resistance constant} = \frac{E.H.P. \times 427.1}{V^3 \times \Delta^{2/3}}$$

$$C_f = \text{frictional resistance constant} = \frac{F.H.P. \times 427.1}{V^3 \times \Delta^{2/3}}$$

$$S = \text{wetted surface constant} = \frac{W.S. \times .09346}{\Delta^{2/3}}$$

$$W.S. = \text{wetted surface in square feet} \left(\frac{(S) \Delta^{2/3}}{.09346} \right)$$

$$V = \text{speed in knots.}$$

$$S\Delta = \text{standard displacement} = \frac{\text{Displacement tons}}{\left(\frac{L}{100} \right)^3}$$

L.C.B. = longitudinal center of buoyancy.

E.H.P. = effective horsepower $\left(\frac{CV^3 \Delta^{2/3}}{427.1} \right)$

Δ = displacement in tons of 35 cubic feet (salt water).

δ = draft ratio, i. e., $\frac{\text{Mid area}}{\text{Beam}^2} = \frac{\text{Draft} \times C_m}{\text{Beam}}$.

ϵ = analysis length of entrance = 1 minus prismatic coefficient of fore body.

ρ = analysis length of run = 1 minus prismatic coefficient of after body.

π = analysis length of parallel body = twice prismatic coefficient of ship - 1.

APPENDIX II

Two examples of the use of this paper are herewith given in detail:

(a) Find the effective horsepower for the following ship at 11.0 knots. Length between perpendiculars and waterline, 420.0 feet; breadth, 53.0 feet; draft, 26.5 feet; mid area coefficient,

.987; displacement, 13,000 tons; $\frac{\epsilon}{\rho} = 0.768$.

$$\text{Block coefficient} = \frac{13,000 \times 35}{420 \times 53 \times 26.5} = .7713.$$

$$\text{Prismatic coefficient} = C_p = \frac{.771}{.987} = .781.$$

$$\delta = \frac{26.5 \times .987}{53} = .4935.$$

$$\frac{V}{\sqrt{L}} = \frac{11}{\sqrt{420}} = .537.$$

From Fig. 19 C for $EX = .720$; for $C_p = .784$. $\frac{\epsilon}{\rho} = .755$.

18 C for $EW = .691$; for $C_p = .767$. $\frac{\epsilon}{\rho} = .688$.

Therefore, by interpolation for proposed ship with

$\delta = .435$	$C = .715$
and with $\delta = .493$	$C = .704$
Length correction	— .003
C for Ann Arbor	.701
C for Washington	.651

And effective horsepower (Washington) = $\frac{.651 \times 11^3 \times 13,000^{2/3}}{427.1} = 1,120.9$.

The actual horsepower of above ship as tested at Washington was 1,122.

(b) What are the best proportions, etc., of a ship of 550 feet length and 21,720 tons displacement for a speed of 16 knots, and estimate effective horsepower.

$$\frac{V}{\sqrt{L}} = \frac{16}{\sqrt{550}} = .682 \text{ and by inspection } .767 \text{ } C_p \text{ is the highest } C_p \text{ possible.}$$

$$\text{Then mid area} = \frac{21,720 \times 35}{550 \times .767} = 1,802.$$

For $\delta = .435B = 64.4$ feet and draft with $C_m = .98 = 28.58$.

From cross curves of Fig. 18 $\frac{\epsilon}{\rho}$ should = .70 and $C = .730$.

$$\epsilon + \rho = 1.00 - \pi = 1.00 - .534 = .466.$$

$$\epsilon = \frac{.70}{1.0 + .70} \times .466 = .1919.$$

$$\rho = \frac{1.0}{1.7} \times .466 = .2741.$$

Therefore fore body $C_p = 1.0 - .192 = .808$; after body $C_p = .726$.

Thus the vessel should be 550 feet $\times$ 64 feet 5 inches $\times$ 28 feet 7 inches draft.

C_p of ship = .767; C_p of fore body = .808; C_p of after body = .726; $C_m = .980$; $L.C.B. = .463 = 254.7$ feet aft of forward perpendicular.

Height of transverse metacenter = .023 B below $WL = 27.1$ feet above base.

$$E.H.P. = \frac{CV^3 \Delta^{2/3}}{427.1}. \quad C = .730 - .018 \text{ (length correction, Fig. 2).}$$

$$E.H.P. = \frac{.712 \times 4,096}{.546} = 5,341.$$

This power would be reduced by increase of draft until $\delta = .485$, at which effective horsepower = 5,220, but there would also be a reduction in KM and stability.

If it is necessary to locate the longitudinal center of buoyancy differently it is possible from the diagrams to estimate the increase in horsepower due to this. If longitudinal center of buoyancy were moved 15 feet farther aft the power would be increased by 200.

Laying Up Great Lakes Vessels for the Winter*

FROM November to March each year traffic on the Great Lakes must stop, for when the ice begins to form navigation becomes impossible. The lake steamers, ranging from 5,000 to 12,000 tons, are then laid up for the winter at their home ports.

During this idle period great care must be taken that everything on the vessels is in order, for when the open season again arrives no time must be lost on engine and hull repairs. Boilers, engines and various auxiliary machinery on board must be protected against corrosion and rust. To this end the external parts of the main engines are covered with a heavy bodied oil or with a mixture of white lead and tallow, as are also the external parts of the auxiliaries. The internal parts of the main engine cylinders and valves are protected with a coating of heavy bodied oil of such a character that it will stick to all of the parts and "stay put." The boilers and all piping throughout the ships are emptied to prevent the possibility of burst pipes from freezing, and the vessels are then placed in charge of a shipkeeper.

Another important item is the protection of the sea cocks and valves, for if freezing takes place and sea cocks have not been protected, they are sure to be burst, with rather expensive results. By protecting these parts with the correct grade of oil, the propelling machinery is ready and in condition when the spring arrives, and the ships are ready to begin their work for the season.

Vessels Built for the Green Star Line

FIVE 9,600 deadweight ton cargo vessels of the *Arcturus* type have been built by the G. M. Standifer Construction Corporation, Vancouver, Wash., for the Green Star Steamship Company, New York. The vessels are 402 feet 6 inches between perpendiculars and 53 feet molded beam. The depth to the shelter deck is 34 feet 6 inches and the molded depth to the lower deck is 23 feet 6 inches. Propulsion is by a set of triple expansion 3,000-horsepower engines, placed amidships, supplied with steam by three oil burning Scotch boilers. The officers' quarters are under the deck house forward on the boat deck, while two deck houses are arranged amidships on the bridge deck. Quarters for the crew are located aft on the poop deck.

* From the October issue of the *Compass*, published by the Vacuum Oil Company, New York.

Fuel Oil for Steamers

Grades of Oil Available for Merchant Vessels and Their Use

BY C. H. PEABODY, DR. ENG.

IN the old days of the galleys, biremes, and triremes, a favorite trick was to get the enemy to row around until he was tired and then pounce on him; today a fleet that has made a forced voyage and worn out the firemen and coal passers would be at a like disadvantage. When the *Esmeralda* in the hands of immigrants came up the Pacific coast the *Charleston* was sent to capture her, for though a band of insurgents ashore may be patriots, the crew that have seized a ship are pirates. However, the question was not brought to issue because the *Charleston* could not get coal into the fireroom fast enough.

The ideal fuel for a warship is a distillate such as has been used on our destroyers, as white and limpid as water and with a high flash point, so that there is no danger in storage or handling. But with the development of hot bulb and Diesel engines there is little chance for so good a fuel on steamers. Yet for warships the oil should flow freely and pump and atomize without heating. Not that heating oil to diminish viscosity is either hazardous or unduly difficult, but that heating introduces complexity.

FUEL OIL FOR MERCHANT VESSELS

The case for the merchant marine is different. The only fuel available is refuse that cannot be distilled or refined. Most of it is the asphaltic base that is found in the Texan, Mexican and South American petroleums. Usually the oil must be heated to pump it and again to atomize it; the latter is of small moment, but provision of steam pipes in oil tanks is troublesome, though it has been found that it is not necessary to heat the whole ocean but that it is sufficient to heat the oil near the intake to the pumps.

Like all problems in business economy, the determination of the saving from the use of oil is involved and complicated; perhaps it would be better that the problem should be stated in terms of relative cost of coal and oil for like economical results. A convenient though crude rule is to say that one can afford to pay twice as many dollars per ton of coal as cents per gallon of oil.

ECONOMY OF OIL BURNING

Some of the elements that enter into the question are bunker capacity, cost of fitting, and the crew and their maintenance. Now coal is broken and does not stow well, so that though oil is lighter there is a direct saving of 10 percent in favor of oil; but the oil makes more steam per pound, so that there is a saving of 35 percent in bunker capacity. The value of this saving is influenced by freight rates. An offset is the cost of fittings, which are much more expensive for oil, and this item goes into the capitalization.

For America, the influence of oil fuel on the size and personnel of the crew is most important; it may be a determining factor. In the first place, the number of fireroom crew may be reduced by half or two-thirds, and a higher class of men can be secured; indeed, a higher class is demanded. There will be some saving in wages and a saving in maintenance, proportional to the number, but the real question is the possibility of getting American citizens for firemen. On coal burners the question is where to find men of any nationality who are willing to endure the inferno of the fireroom.

With the introduction of oil fuel comes a demand for greater intelligence and skill on the part of engineers and firemen, for oil can be burned with all sorts of results, both

good and bad. There is range enough in burning coal between results from competent and incompetent crews, but there is a limit, for if the fire gets into a really bad condition it may go out, while oil will just keep on burning so long as it is supplied to the furnaces.

METHODS OF ATOMIZING THE OIL

There are three methods of atomizing the oil: by the use of steam, by the use of compressed air or mechanical atomizers. For shore stations, steam atomizers have long been used with entire satisfaction; about 2 percent of the steam generated in the boilers is used by the atomizers, but as a boiler efficiency of more than 80 percent can be maintained, we cannot expect much better.

At sea the waste of so much fresh water is undesirable, and so it was first proposed to use compressed air, and with the proposal was the idea that the air used in the atomizer would so aid combustion as to improve economy, but there was nothing in it. The cost and trouble of compressing air precludes the use of this method and there is no reason for further consideration of compressed air because mechanical atomizers are entirely satisfactory.

There are a large number of satisfactory mechanical atomizers, all of which work by ejecting oil under a high pressure with a whirling motion. The desiderata are simplicity of construction and ease of cleaning. Spare atomizers are carried so that any one may be readily replaced. They are made in all sizes from those adapted to launch boilers to those delivering the astounding quantity of 2,000 pounds of oil per hour. Such burners have given a boiler efficiency of 80 percent, leaving little or no chance for improvement by any method. Using such burners the enormous horsepower of 180,000 for our new battle cruisers can be obtained by using eighty or a hundred burners.

The one defect of the mechanical atomizer has been that when the flow of oil was reduced to half capacity the whirling velocity was not enough to properly atomize the oil. Recent improvements have succeeded in maintaining the velocity when the flow is reduced to 10 percent of the normal, and, consequently, burners can work under all conditions of service.

It is exceedingly important that good combustion should be maintained; too much air may act mainly to heat the atmosphere. Too little air is worse because it not only spoils the efficiency but soots up the boiler, which is always bad and is anathema for watertube boilers.

A method in common use is to watch the funnel; when there is a slight haze, the combustion is about right. Another method is to watch the fire through observation holes. Certainty of best results can only be obtained by gas analyses to determine existence of carbon monoxide or excess of air. This is a new demand on the operating engineer, though familiar enough to the engineering expert.

OIL PIPING

The oil piping must be above suspicion, especially in or near the engine room, because leakage is extremely dangerous. The navy, partly for the sake of lightness, uses drawn steel pipes with flanges expanded on; for merchant service, welded pipes with screwed flanges are sufficient. After all, the real demand is for good workmanship to make a tight job. And where there is a good job there should be eternal vigilance to

detect the first signs of leakage no matter where it may occur.

Since the oil is viscid, pipes and valves must be generous; a suction velocity of 20 feet a minute being usual, with a discharge velocity of 100 feet per minute. Heating coils are provided around the suction in the oil tanks and heaters are supplied in or near the fireroom for the atomizers. There are usually two heaters, one being a spare; or, better, there may be three, with two in service and the third for a spare. The early heaters had steam coils, but the present practice is the reverse with oil in the coils. The oil should not be heated above the open flash point, although there appears no great danger, since the oil is under pressure in the pipe until it passes the atomizer.

METHOD OF STARTING BURNERS

Boilers having steam atomizers can be started by building a wood fire under one of the boilers; if the plant is of considerable size there may be a donkey boiler that can be started with wood and thus get up steam for the pumps and atomizers. At sea, where viscous oil is used with mechanical atomizers, there will always be a donkey boiler and there must be some sure and easy way of getting steam on it. A conservative way is to have means for burning coal; at any rate, for starting. Any seagoing engineer will appreciate having a banked fire which needs only to be opened up when steam is needed. There are devices in the market for burning oil in an open pan or trough. Even when mechanical atomizers are used under the main boilers it is convenient to have steam atomizers for the donkey boiler, which arrangement should not make too much demand on the fresh water supply, or on the distilling apparatus when one is supplied. If, however, the donkey boiler has a mechanical atomizer, there may be a hand pump to work it while getting up steam.

As for safety, an oil with a low flash point in properly constructed tanks is safer than coal, for there is no chance of spontaneous combustion. It would be difficult to set such a tank on fire unless an external conflagration is strong enough to heat it up toward its flash point. The tank must, of course, be properly riveted and have adequate bulkheads and expansion trunks and swash plates should be provided when necessary, all of which is ordinary construction by a good shipbuilding company. The item of construction demanding greatest care and good workmanship is the oil piping, as has already been said.

With the present demand for gasoline, there is little occasion for considering the use of raw oil for fuel at sea; the gasoline is pretty sure to be topped off if no further refining of the oil is done. Perhaps tankers carrying crude oil will be arranged to burn that oil under the boiler; in such case safety can be had only by exercising eternal vigilance, for crude oil with all the lighter components in it is a most dangerous material; it is very much worse than gasoline. Should any combination of circumstances lead to the use of crude oil on a freighter, then all the precautions and methods of construction used on crude oil tankers to guard against conflagration and explosion must be provided and the engineers and firemen must be properly instructed and cautioned.

JUDGING THE QUALITY OF FUEL OIL

In judging the quality of fuel oil, three properties are considered: the viscosity, density and the heat of combustion. Since the convenience or even the possibility of pumping and atomizing depends on the viscosity, it is the first and most important of the three. Unfortunately, there are three or four different kinds of viscometers; they differ so much that it is difficult to interpret one in terms of another. Probably any one could be made to serve if it were standardized and universally used. It is doubly unfortunate that there is a tendency to solve the problem by using some entirely different method. However, an expert may familiarize himself with all and only an expert can be expected to get results.

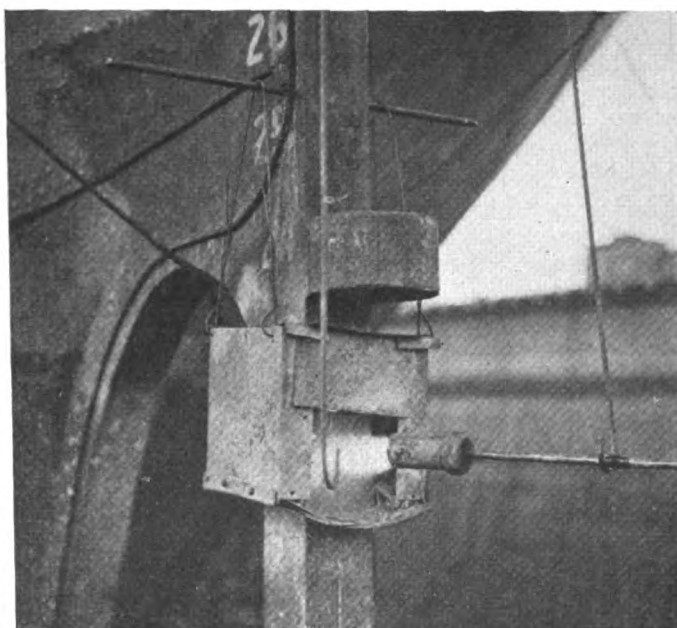
There is some relation between density and viscosity,

though it does not appear to be well known and undoubtedly varies with the composition of the oil. This is probably the reason why the determination of density is important. The usual way is to determine density by a hydrometer using the Baume scale, though the viscosity of oil makes it unsatisfactory; the advantage is that any intelligent person can learn how to use that instrument. Probably an expert could make direct determinations of the specific gravity compared with water by the use of the specific gravity bottle.

The heat of combustion is determined in the usual method for fuels, and must be done by a specialist if reliable results are to be had. Incidentally, it may be said that sulphur in the proportion found in petroleum is not troublesome when the oil is used for making steam. There is less variation in the total heats of various oils than is found in the endless varieties of coal, anthracite, bituminous and lignite, not to mention intermediate grades. Nevertheless, oil should be sold on its capacity for developing heat and should be guaranteed for viscosity. Since oil companies must have a staff of experts, the most economical way is to have all determinations of properties made by such experts and guaranteed by the company.

Stern Frame Straightened in Dry Dock

WHEN the steamship *S. B. Hunt* was docked for repairs by the Morse Dry Dock & Repair Company, Brooklyn, N. Y., recently it was found that the stern frame was buckled and curled and the rudder pintle bushings worn out. To follow the ordinary procedure in repairing this damage meant that the stern frame be disconnected three or four



Heating Stern Post on Steamship *S. B. Hunt*

plates taken out, and the stern frame removed; then the sending of the piece to the shops to be faired, machined and later to be replaced.

Such procedure was waived; it meant a loss of considerable time, much more labor and increased costs on that particular job. It was decided that the frame could be straightened without its being detached from the ship, and an all-night gang was assigned to the work. They built heating boxes, used kerosene blowers, coke filling, differential pulleys and hydraulic jacks. Heats were applied with pressure and the buckled stern frame was straightened.

It has been estimated that the actual work saved the shipowner \$25,000, to say nothing of the time his vessel would have been laid up under the ordinary routine—probably from 25 to 30 days.

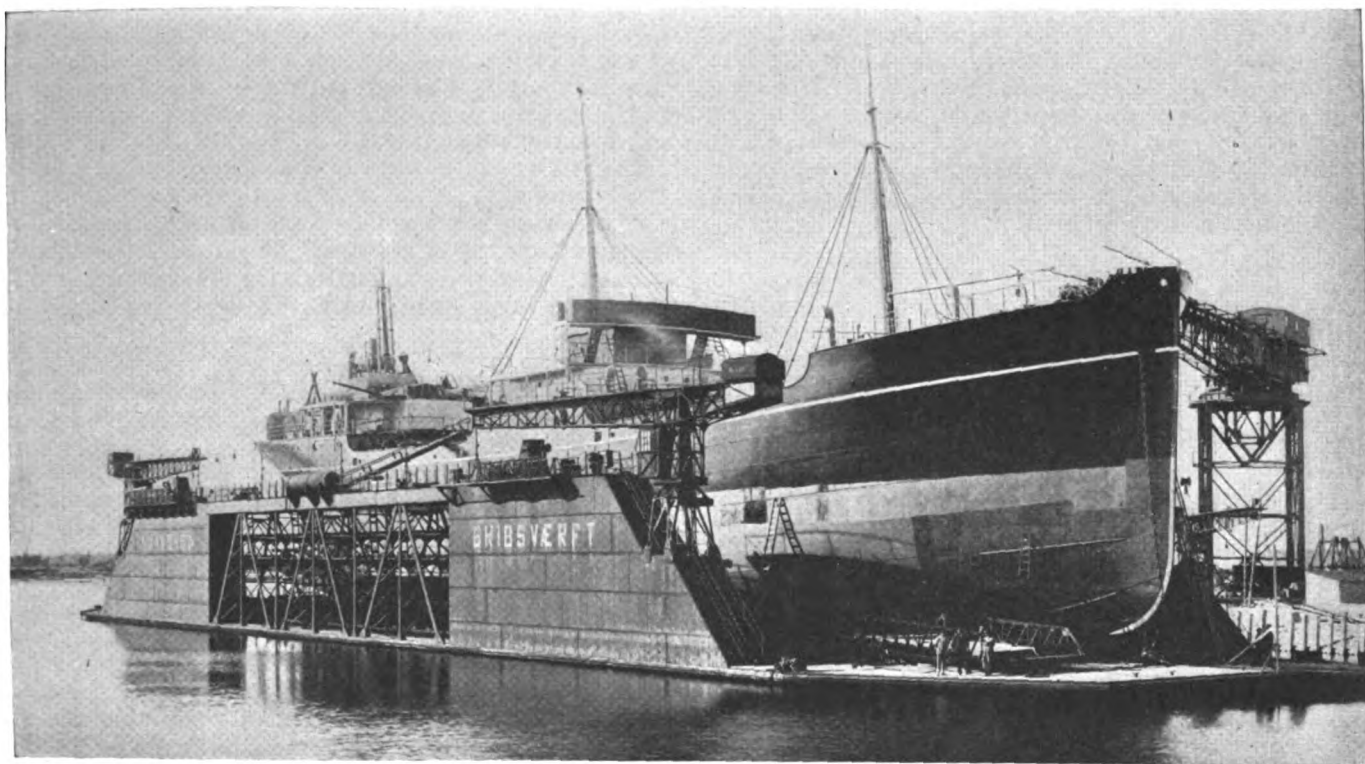


Fig. 1.—The Motor Tank Ship *Mexico*, 6,000 Tons, Built for the East Asiatic Company. She is Equipped with Two Holeby Four Cycle Diesel Engines of 800 Indicated Horsepower Each

Conversion of Steamers to Motor Craft

British Coal Strike Boosts Development of Motorships—Number of Existing Steamers to Be Converted into Motor Vessels

BY OUR SPECIAL LONDON CORRESPONDENT

BY a curious coincidence, just at the outbreak of the coal strike a tramp steamer that had been converted to a motor vessel in Germany called at a British port on her maiden voyage and created an immense amount of interest among British shipowners. This vessel was the *Augusta* belonging to the Banck Line, of Stockholm, and was a typical tramp steamer. Owing to the excessive price of coal and the difficulty of obtaining it, the owners decided to install a 1,200 indicated horsepower (800 brake horsepower) Sulzer engine instead of the same steam engine of approximately the same shaft horsepower.

After the conversion had been carried out it was found that the consumption, which with coal had been 18 tons per day, was reduced to four tons of oil, the average saving on the fuel bill being approximately 50 percent. In addition, the *Augusta*, which as a steamer carried approximately 5,000 tons of cargo, is now able to load 5,300 tons on account of the smaller space occupied by the machinery.

TWO CYCLE ENGINE IN FAVOR

British engineers are tending towards the two cycle type of Diesel engine in spite of the success of the four cycle principle, and the installation in the *Augusta* represents the latest trend in two cycle design. The power of 800 brake horsepower is developed in four cylinders and the usual Sulzer system of scavenging by means of two sets of ports in the cylinder is adopted. A novel feature is the control of the engine from the upper platform instead of from the engine floor level, which is the usual arrangement. The main object of this is to eliminate as many levers and shafts as possible,

for the control wheel acts directly upon various shafts. Since the conversion the machinery of the *Augusta* has run without the least trouble, which is a good augury for the many vessels now being built in Great Britain in which machinery of the same class is being installed.

The novel Cammellaird-Fullagar engine which aroused so much comment in America is exceedingly well thought of in England, and the operation of the first set in the 500-ton coasting vessel *Fullagar* appears to have pleased the owners. The engine is of 500 horsepower, and since the vessel was commissioned a few months ago she has run 10,000 miles with complete success. The power is, however, obviously too much for the size of the boat, and the owners have therefore ordered a second engine of the same power, and when completed the two sets (the new engine and the one from the *Fullagar*) will be installed in a new 4,000-horsepower motorship now under construction for the Brocklebank Line. A smaller motor will then be installed in the *Fullagar*.

CAMMELLAIRD-FULLAGAR ENGINE PROVES RELIABLE

This fact would seem to indicate that the new engine has proved its reliability and that it is likely to become a sound commercial proposition. However, it should be pointed out that in the present engine some of the main difficulties which will be met with in opposed piston motors have not yet been encountered. For instance, as is well known, the liner in an opposed piston engine is a most vulnerable feature, but difficulties are only likely to be encountered in fairly large sizes, say in diameters greater than 25 inches. No Cammellaird-Fullagar engines with cylinders of this size have yet been

built, so that it would be as well to defer an ultimate opinion regarding the suitability of this motor for exceedingly high powers until further experience has been gained. This is not in the least to suggest that insuperable difficulties will be met, but merely to point out that satisfactory experience with small engines does not necessarily imply that immediate and complete success will be attained with motors of several thousand horsepower.

NEW ORDERS PLACED FOR MOTORSHIPS

There is no depression in the motorship building industry in Great Britain, and many new orders have recently been placed. The British Tanker Company, Ltd., has contracted with William Denny and Brothers, Dumbarton, for a 10,000-ton tanker, 425 feet in length between the perpendiculars, with a beam of 56 feet 8 inches and a molded depth of 33 feet. In this vessel two 1,350 brake horsepower four cylinder Sulzer engines will be installed, but although Dennys are licensees for Sulzer motors, no doubt they will be mainly built at the Swiss works.

The Royal Netherlands Steamship Company has ordered a 2,200-ton vessel fitted with an 850 brake horsepower Werk-

with British shipowners at the present moment. The machinery comprises two 2,330 indicated horsepower Diesel engines of the new type built by the North British Diesel Engine Works, Ltd., having eight cylinders 26½ inches diameter and 47 inches stroke.

The new vessel is modern in regard to speed, for it is designed to maintain 12½ knots at sea with the engines running at 96 revolutions per minute. Electrical auxiliaries are used throughout, the power being supplied from Diesel driven generators installed in the engine room coupled direct to six cylinder 300 brake horsepower high speed oil engines.

The Motor Tanker Mexico

BY C. E. SPINNLER

WITH the ever-increasing use of oil burning installations on steamships of all classes, as well as the increase of Diesel-driven motorship tonnage, a serious shortage of transportation facilities for the necessary large quantities of fuel oil has been felt during the past few months.

Shipowners and operators are in general dependent on the tank ships controlled by oil-producing companies both here and abroad (about 75 percent of the foreign control is in the hands of British companies). Since the Government tankers and most of the tankers owned by the oil companies are used for supplying the fuel stations throughout the world, private concerns have been more or less depending on deliveries of oil that are made at the discretion of the producers.

To avoid delays in bunkering the ships of its fleet, and to escape having to rely on supplies from fuel stations of the oil companies, the East Asiatic Company, of Copenhagen, which controls a large fleet of motorships, has commenced to build up a tank fleet of its own and provide storage facilities for fuel oil at various ports on its trade routes.

The first of the tank ship fleet, the *Mexico*, was built at the Malskov Yard in Denmark. Before her acceptance by the owners, the ship completed a successful trial trip, after which she left Copenhagen in ballast for New York. Her maiden trip across the Atlantic was very rough, but she arrived in good condition, having been twenty days in crossing.

She went directly to Bayonne to take aboard a full cargo of crude oil, gasoline and a small amount of bulk freight, completing her loading in two days. The vessel then started on her return trip to Copenhagen.

The motorship *Mexico* presents the same general appearance as other vessels of the East Asiatic Company's fleet and is of the general standard Burmeister & Wain type of motorship construction. She is a twin screw vessel with the engine room aft and has the following dimensions:

Length overall	317 feet
Breadth, molded	44 feet
Depth, molded	38 feet
Deadweight cargo carrying capacity.....	4,700 tons
Indicated horsepower	1,780
Speed of ship, loaded	10 knots

The total bunker capacity of 400 tons gives the vessel a cruising radius of about 67 days, or approximately 16,000 sea miles.

The engine crew of the *Mexico* consists of eleven men, i. e., one chief engineer, three engineers, four assistants and three oilers.

Power is supplied by two six-cylinder Holeby Diesel type engines having cylinder diameters of 19¼ inches, a piston stroke of 29½ inches and a speed of 140 revolutions per minute. The rating for these engines has been given as 800 shaft horsepower per engine, but an analysis of the engine dimensions would seem to indicate that the rated horsepower of 800 shaft horsepower per engine represents the maximum capacity at overload. It can hardly be expected that these engines will run at so high a mean effective pressure as 111

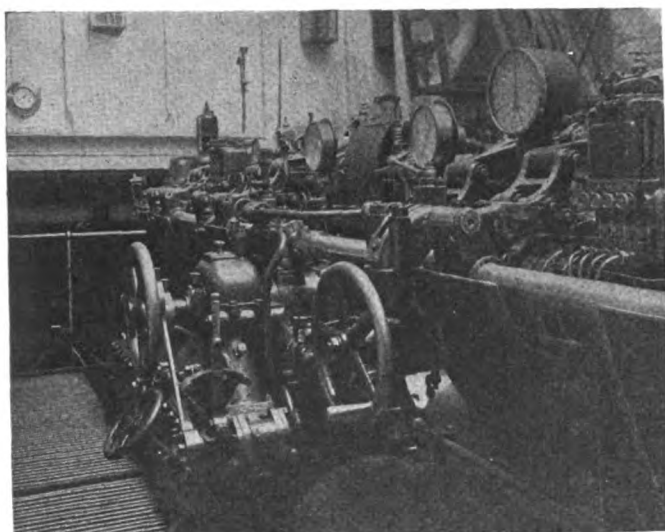


Fig. 2.—Control Station of the 1,200 Horsepower Sulzer Engine in the Converted Ship *Augusta*

spoor motor, while two more ships equipped with 3,000-horsepower Doxford engines are to be built. Moreover, the Pacific Steam Navigation Company has just ordered three further 12,000-ton motorships from Harland and Wolff, making six in all, the first of which, the *La Paz*, recently sailed on her maiden voyage to New York, then through the Panama Canal to the west coast of South America. In addition, the Chargeurs Reunis, one of the largest French shipping firms, has ordered a cargo boat of 11,700 tons in which two 1,700 brake horsepower Sulzer engines will be installed.

TENDENCY TOWARDS STANDARDIZATION

The development towards standardization in motorship construction is becoming very marked. The vessel which is now under construction for the Union Steamship Company, of New Zealand, at Denny Brothers' yard on the Clyde, of which illustrations are given, is one of a series of exactly similar vessels, several of which are being built for the British India Steam Navigation Company. In the case of the latter, however, although the hull form remains the same, the accommodation has been provided for passengers, whereas the vessel for the Union Steamship Company has been designed purely as a cargo craft. The length is 450 feet, the beam 58 feet, and the depth 34 feet, the carrying capacity being in the neighborhood of 11,000 tons, a very popular type

pounds per square inch under service, which pressure would be necessary to obtain the rated horsepower.

Assuming that the Burmeister & Wain standard pressure, i. e., 6.25 atmospheres, or 92 pounds per square inch, is the basis for computing the rating of the installation, each engine turning at a speed of 140 revolutions per minute, the capacity would be 838 indicated horsepower for each engine, or a total of 1,676 indicated horsepower for the vessel, as against the 2,100 indicated horsepower of the builders' rating. With an estimated mechanical efficiency of 76 percent, the shaft horsepower of each engine will actually be 636, or a total of 1,272 shaft horsepower, which will represent quite nearly the correct engine output at sea. The actual fuel consumption of the *Mexico* of 0.314 pound per indicated horsepower per hour and the total fuel consumption of 5.75 tons per 24 hours (as recorded on the maiden voyage), including the Diesel-driven auxiliaries which were running at sea, would indicate that the above calculations were correct. Using these figures as a check, we have the following result:

Indicated horsepower =

$$\frac{\text{Fuel consumption per 24 hours}}{\text{Fuel consumption per indicated horsepower per 24 hours}} = \frac{5.75 \times 2,240}{24 \times 0.314} = 1,700.$$

This value corresponds with the calculated output using the Burmeister & Wain figures as a basis. The total shaft horsepower with a mechanical efficiency of 76 percent will be:

Shaft horsepower = $0.76 \times 1,700 = 1,292$, as against 1,272 shaft horsepower calculated.

From this figure the daily fuel consumption will be 0.415 pound per shaft horsepower per hour, which also agrees very closely with the fuel consumption on other Burmeister & Wain ships, i. e., the *California*, the *Stureholm* and others. As the vessel has fine lines, the loaded speed of 10 knots attained on the trip across was quite reasonable and was, in fact, slightly surpassed on the trials of the vessel in Denmark.

The lubricating oil consumption is about 7.5 gallons per day. The forced feed system is used on the engines.

CONSTRUCTION OF THE ENGINES

The main engines, as previously indicated, are of the six cylinder Holeby four-cycle type built by a subsidiary firm of Burmeister & Wain and are to a certain extent copies of the Burmeister & Wain type engines with slight differences in certain of the structural details.

Each cylinder head contains one inlet valve, one exhaust valve, one starting valve, one release valve and one fuel injection valve. The injection valve is a departure from the Burmeister & Wain standard open nozzle type valve and is similar to the needle valve installed on nearly all marine Diesel engines. The valve gear is also slightly different in its minor details from the Burmeister & Wain practice, being more like that used in the McIntosh & Seymour engine. The reverse mechanism is the same as that adopted by Burmeister & Wain.

Each engine has a three-stage air compressor mounted on its forward end driven from the crankshaft. Air at about 1,000 pounds per square inch pressure is supplied by the main compressors for fuel injection. A small bilge pump is driven from the compressor crankshaft extension.

The cylinders, valve heads, compressors, inter-coolers, exhaust manifolds and crosshead guides are cooled with sea water, while the pistons and thrust collars are oil cooled.

As in the other motorships of the East Asiatic Company, all the auxiliaries, both engine room and deck, are electrically driven.

The auxiliary machinery installation consists of:

Two electric generating sets, each made up of one high speed, two cylinder Holeby Diesel engine of 100 brake horsepower, running at 300 revolutions per minute, directly connected to a 70-kilowatt dynamo rated at 230 volts and 300 amperes.

One maneuvering, two stage air compressor directly connected to a 50-horsepower electric motor running at 250 revolutions per minute.

Two centrifugal water circulating pumps for supplying cooling water to the engines, each connected to a 12-horsepower electric motor running at 1,000 revolutions per minute. Incidentally, each pump has sufficient capacity to maintain complete service for both engines in cases of emergency.

Two double-gear pumps for circulating lubricating oil, each connected to a 10-horsepower motor operating at 500 revolutions per minute. These pumps are also of sufficient size to maintain complete engine service.

One general service and ballast pump of the rotary type, driven at 200 revolutions per minute by a 10-horsepower electric motor turning at 750 revolutions per minute, through reduction gearing.

One two-plunger vertical bilge and sanitary pump driven by a 7.5-horsepower motor having a speed of 1,000 revolutions per minute, which operates the pump at 80 revolutions per minute through reduction gearing.

One fuel, air-driven, transfer pump of the duplex type, having a capacity of about 5 tons per hour.

Two electric turning gears each driven by a 5-horsepower motor.

One steam-driven air compressor, about 5 horsepower, for emergency service.

In the engine room aft of the main engines a small workshop, equipped with machine tools, has been installed, so that repairs of a minor nature may be carried on at sea and in port without help from outside. Power is supplied to the tools by a 5-horsepower motor.

The fuel tanks for the daily supply are located on the forward engine room bulkhead and have a capacity of about 2 tons each. At the outboard side of each engine, air storage tanks are provided for starting. A pressure of about 350 pounds per square inch is maintained for this purpose.

Mounted on a gallery over the thrust blocks is a Scotch type two-furnace, oil-fired donkey boiler. This boiler is installed to provide the necessary steam for steaming out and heating the tanks and for operating the steam cargo pumps. All living quarters are steam heated. The boiler is built to carry a pressure of about 100 pounds per square inch.

Steam- and electric-driven cargo pumps are provided and are located in separate compartments.

For ventilating the tanks and for cooling the electric motors, electric-driven blowers are installed in the same compartment as the control apparatus for the cargo pumps. All motors are of spark-proof design and completely inclosed.

The electric-driven cargo pumps of the vertical three-plunger type are connected to 40-horsepower and 60-horsepower motors through reduction gears. Steam pumps having the same capacity are arranged in a separate compartment and are used for pumping light oils and gasoline.

The steering gear is of the Hele-Shaw hydro-electric type and is driven by a 12-horsepower motor operating at 730 revolutions per minute.

All winches, capstans and windlasses are electrically driven and are of the standard design adopted by the East Asiatic Company.

The galley of the *Mexico* has been equipped with electric appliances of various kinds, among other equipment being three boilers heated by a current of 60 amperes; two ranges, one having two holes and the other four holes. The galley was built and installed by the Danish firm Vesta, of Copenhagen.

Piston and Rings for Heavy Oil Engines*

Solid and Forged Pistons Discussed—Method of Forming Piston Rings from Castings—Assembling Forged Pistons

BY W. D. FORBES

SINCE the pressure from combustion in a cylinder is exerted on the moving piston, it is evident that between its sliding circumference and the wall of the cylinder there should be no leak, as otherwise the compression would be reduced and the power lessened. It is evident, therefore, that the most important part of the piston is its rings. We will, however, consider the piston first.

The material for the piston may be a steel casting, cast iron, or a forging.

Two general forms are used; that is, the hollow and the solid types. Designers often state that a hollow piston must be a casting, but this is not correct, for the best design for an oil engine piston is a steel forging. There is no difficulty in making such a piston hollow, for the material allows small cross-sections to be used and greater lightness obtained.

A single piece, or solid piston, should not be considered seriously, for, although it is simple and cheap in first cost, it has the great disadvantage of transmitting the heat of the expanding gases through it far more quickly than if the hollow style is employed, and it does not permit arrangements for cooling. Hollow forged pistons must be made in two or more pieces so that they may be machined.

What is known as "steeping" in a piston is resorted to in order to obtain a long piston rod stuffing box without raising the center of gravity of the engine, which, of course, in marine work should be kept as low as possible. As the top of the piston is steeped, the lower end is recessed to correspond, thus allowing the stuffing box to extend into the cylinder, thus saving height.

In making a cylinder cover, the slight amount of extra metal which is coned up to allow the piston to rise is very small and does not affect the center of gravity enough to count.

PRODUCING FORGED PISTONS

In making one or two pistons only, the cost is large, as a solid forging or forgings would have to be used. To turn these out takes time. However, if the design is one which has proved efficient, hollow forgings can be made cheaply by the use of dies and the cost of the machine work thereby much reduced.

In a forged hollow piston construction it is only necessary to imagine two cup-shaped forgings placed opening to opening, one recessed into the other and the two pieces held together by the piston rod. If the piston is not steeped, a single forming die will answer for both top and bottom pieces. If the piston is steeped, two sets of dies have to be used for the top and bottom halves. This construction is simple, and the inside of the parts need not be too finely finished in the machining process, although the final cuts should leave the surfaces smooth so that they can be wiped off with waste. The joint may be recessed or made by threading.

The inside of the piston halves must be turned to allow for the recessing of the rings, as it would add greatly to the weight if the sides of the piston were not kept nearly uniform in cross-section. This work takes time, but not much more than is required to machine the surfaces if a casting is used. A casting must also be machined on the inside in order to insure an even section and to make certain there are no flaws

of any kind. Many forms of hollow cast pistons cannot be internally machined.

As the ends of the pistons are subjected to the greatest heat, it is well to have the diameters here somewhat smaller than at the middle. The coning of the piston must not, however, be continued to the middle of the piston, but only about an eighth of a diameter at each end, so that a parallel section is found at the middle. It is of great importance to keep the cross-section of the piston even, as in so doing the more even expansion prevents the distortion of the piston and ensures far better working of the engine. The piston, of course, must be somewhat smaller in diameter than the bore of the cylinder and should vary as noted above. Just what reduction should be made must be determined by the material used in the piston and by actual experience. Steel makers state that they can furnish steel which will expand only very slightly, while castings are sometimes very erratic in expanding, no two acting the same.

The fit of the piston should be as tight as possible and still run free; in other words, the piston should just clear the bore under running conditions. This matter of clearance is one which should be determined almost entirely by experiment, but this does not imply that an empirical determination should be resorted to for each piston built. It is inexcusable not to decide the exact clearance for a certain type engine after the first piston is fitted satisfactorily. Once the required clearance for a given size and design cylinder is found, all subsequent engines should be machined accordingly and no further trials need be made to be certain that the pistons fit correctly.

FUNCTION OF PISTON RINGS

The fundamental idea of the piston ring is to furnish an elastic medium between the wall of the cylinder and the piston in order to prevent the gases from leaking, thus reducing the compression.

The material for the rings is cast iron and the selection of its quality is difficult, as foundrymen cannot be depended upon to give exactly the same mixture in each heat. It has been my experience that even when exercising every precaution the material in cast iron piston rings will vary quite enough, even when poured at one heat, to give both good and bad results. This variance probably arises from the difference in temperature of the metal when poured and the care taken in cooling the castings. The iron should be soft and fairly close grained, but not too fine—in fact, it is much better to have the iron too open rather than too close.

An empirical rule for determining the width of the ring is to place a decimal point between the figures of the diameter and divide by two. This is true, of course, for cylinders less than, say, 48 inches in diameter. For a 28-inch piston the ring would be 1.4 inches wide. The thickness of the ring should be a little less than half its width. In considering the thickness of the ring we must first determine whether an eccentric or concentric style will be used.

METHOD OF MAKING CONCENTRIC PISTON RINGS

It has generally been found that concentric rings of diameters up to 48 inches give better results than the eccentric type, so we will only consider the former style.

There are, of course, several methods of making piston

* Second of a series of articles dealing with the design of reciprocating parts for oil engines. The first article appeared in the November issue.

rings, and engineers will do well to follow what has proved satisfactory to them rather than adopt any new method.

The pattern for the concentric type ring is made in the form of a cylinder with a flange at one end. The outside diameter of the pattern must be determined by the amount of spring that the designer considers necessary, and this spring depends as a matter of course on the quality of the cast iron. The casting is chucked with the flanged end out, and the face and edge of this flange are turned up with a smooth cut, the diameter being brought to size by gage. A slight recess is turned in the face plate of the lathe to meet the diameter of the flange. Of course, in first chucking the casting care is taken to insure having it run as true as possible. Into the recess in the face plate the casting is placed and clamped securely. A roughing chip is taken both inside and out and the front edge of the casting is also faced. After this roughing cut is taken, which must be deep enough to get well under the scale, the casting is taken out and another casting machined in a like manner. Of course, if quite a number of castings are being turned out, all the flanged ends are done first to save time. These roughed castings are then allowed to "season"; just how long is debatable, but certainly not less than two weeks.

If time presses and the casting must be used at once, it should be steamed for about ten minutes, more or less, according to the diameter of the ring and the temperature of the steam, allowed to cool and steamed again. At least four steamings should be given it. Time and steam take out the strains set up in the casting, and if they are not relieved the ring will not retain its roundness and will show bright in places after a little running. These hard spots arise from a poor mixture of iron, and the thing most desired in the metal of a piston ring is uniformity in hardness.

The finished size both inside and outside of the ring having been settled upon, the casting is again placed in the lathe, the recess turned in the face plate, allowing it to be set at once accurately. The casting is then bored and turned to size, the front end just skimmed off and a parting tool, or a gang of them, used to part off rings, leaving them wide enough to allow a good finishing cut on both sides.

The parting tool or tools should be ground so that the ring will be cut clean, and this is accomplished by having the ends of the parting tools beveled to the left. Because of this bevel the ring will be parted by the tool point before the left-hand edge of the tool finishes its cut. If several tools are used in a gang, the right-hand tools should lead the work so that the machinist can catch a ring as parted and be ready for the next, otherwise the rings parting all at the same time may be broken, as the machinist cannot catch them all at once.

When the casting is all worked up the rings should be taken to a milling machine and halved down, and this halving must be taken into consideration when determining the outside diameter of the ring, as the lap must be equal to the width of the ring. The inside bore of the ring is completely finished in the boring process and the cut must be fair and smooth. The outside diameter as well as the bore in these operations must be brought to a gage. The joint at the halving down must next be scraped to a nice surface, or, more properly, to two scraped surfaces. In order to do this scraping, a board should be provided on which are stops over which the ring is sprung enough to open the halving so that the inner edges of the laps or tongues can be easily reached. A fine file should be used to turn the inner edges of the laps so that any burr left in milling is removed. The vertical cuts of the halving need not be scraped, as they should always be somewhat open.

The joint having been finished, the ring should next be taken to a lathe fitted with a solid face plate in the face of which is turned a recess a little less deep than is the ring

and just right in diameter to allow the split ring to be sprung together so that the halving is not quite closed.

FINAL FINISHING OPERATIONS ON PISTON RINGS

A light finishing cut is then taken off the first edge of the ring and it is removed, reversed and the second side finished, bringing the width of the ring to gage. In order to be able to use a gage on the ring, a piece must be cut out of the face plate—in fact, it is better to have two such cut-outs in order to be able to see that the ring has not been "cocked" in reversing it. The ring is now complete except as to its final outside diameter.

This final sizing requires a rig consisting of a solid face plate fitted to a lathe, on which is turned a diameter corresponding to that of the inside of the ring when the halves just miss butting. A flange turned to the diameter of the cylinder bore is left back of this turned diameter. The width of the ring determines the width of the turned part, but it should be just a little less than the ring width. A plate having a bored hole in its center which fits closely over a concentric stud in the center of the face plate is turned up to the diameter of the cylinder bore. A nut and washer are provided for the stud.

If, now, the ring is placed on the face plate and sprung together and the plate brought up against the ring and the nuts tightened, it is evident that the ring will be held securely between it and the face plate. The outside diameter of the ring can now be turned off to the bore of the cylinder and the ring is complete.

A word can be said as to springing the ring together on this fixture for the final turning. If this springing is not done properly the ring will not come out even in thickness. A flexible band, such as a small chain fitted with a roller sheave on one end, will draw the ring together evenly. This is only practical on small rings, but on large ones a steel hoop turned out on the inside and drawn together by means of a screw passing through the two bent out ends of the hoop serves the same purpose.

In order to prevent the ring joints from coming into line, pins are set in them or into the piston to keep the joints staggered. The pins need be but small and they should be set in the piston and holes drilled in the rings to meet them. The pin holes should not go entirely through the rings, as it weakens them. It is a little troublesome, however, to drill the holes and have them register from the inside, though it can be done with a geared breast drill, or if the ring is large a small sensitive drill press can be used. The holding pins should be so placed as to break the joints; their exact position is of no moment. If there are any parts crossed by the ring in its movements, the joints should be so placed as to avoid them, the hole in the ring being directly opposite the joint.

The number of rings described would not answer for very large pistons, but as yet the oil engine has not been made so large in its cylinder diameter as to require any other form.

A piston ring which it was claimed could be used up to 72 inches in diameter and seemed to be practical was shown to me by an Englishman a few years ago. It was made concentric, but having a U-shaped cross-section with the U looking toward the center. Two parallel members stiffened the ring. This stiffness was also increased by the use of a small machine which peened the surface of the rings between the parallel members. The strokes of this machine could be varied so that the rings were stiffer opposite the joint. A ring so treated should be satisfactory and the peening machine should be quite as satisfactory on a ring that is not recessed as on one that is.

If the lathe work is done properly, the edge of the rings should only be scraped enough to remove the fine, velvet sur-

(Concluded on page 1013.)

Naval Architects Meet in New York

Society of Naval Architects and Marine Engineers Holds Twenty-Eighth General Meeting—Abstracts of Papers and Discussion

THE twenty-eighth general meeting of the Society of Naval Architects and Marine Engineers was opened in the Engineering Societies building, 29 West 39th street, New York City, on Thursday morning, November 11, with Homer L. Ferguson, president of the Newport News Shipbuilding & Dry Dock Company, in the chair. Rear Admiral Washington L. Capps, U. S. N., president of the society, was absent from the meeting because of official duties which called him to the west coast. The secretary-treasurer's annual report was read by Daniel H. Cox and approved.

Membership in the society has been increased during the past year by 114 members, 65 associate members and 9 juniors. The elections this year brought the membership of the society up to 1,778 as compared with the 1,590 members of last year. The financial report indicates that the balance from the preceding year and receipts for the present year amounted to \$34,594.03, while the total expenditures amounted to \$20,162.87. The resources of the society at the present time total \$54,680.21. This amount, known as the endowment fund, is intended for the development of activities and investigations outside the general work of the society.

The following deaths were reported during the past year: Members, William Boyd, Charles B. Calder, J. Irving Chaffee, Edwin Mills, William T. Nevins, Gustav Prechazka; associate member, Henry L. Gantt.

In concluding his statement in connection with the annual report, the secretary pointed out the necessity of increasing the annual dues of the society to meet the increase in general operating expenses which the society has met with during the past two or three years. During the past year the society has found it necessary to increase the secretarial staff of the organization. Further than this, an extension of the activities of the society by having more frequent meetings, by establishing local sections and affiliations with kindred societies, all of which involve additional expense, have been considered as quite essential to the development of the society, but which are impossible under the present financial status.

Amendments to the constitution covering the new membership and associate membership dues of \$15 and junior dues of \$10 were passed unanimously.

ELECTION OF OFFICERS

The following officers were elected for the terms specified:

Honorary Vice-presidents—W. F. Durand, W. J. Baxter.

Vice-presidents (for term expiring December, 1923)—H. L. Ferguson, F. L. DuBosque, H. A. Magoun, W. A. Dobson.

Members of Council (for term expiring December 31, 1923)—H. C. Sadler, D. H. Cox, C. F. Bailey, W. H. Todd, E. H. Rigg, W. McEntee.

Associate Members of Council—H. L. Aldrich, H. H. Raymond.

Secretary-Treasurer—Daniel H. Cox.

Life Member—Andrew Fletcher.

REVIEW OF CONDITIONS IN INDUSTRY

In his opening address Mr. Ferguson pointed out that "there has been a gradual and sure development of comparatively new ideas in design and shipbuilding during the past year. Oil burning in steam boilers has more and more tended to replace coal as fuel, and on account of the greater convenience and lessened labor has almost become a necessity." Continuing, he said:

"In spite of some setbacks, geared turbines of suitable design are produced by so many that their success is generally accepted. The internal combustion engine is probably receiving more attention at this time than any other one item, and the increasing use and effectiveness of this type of engine may be confidently expected. Electric drive for war vessels has become a demonstrated success in spite of some troubles and is being adapted to merchant ships as well.

"In shipbuilding the growth of the use of oxy-acetylene and of electric welding is one of the most noteworthy developments of recent years, and it would be difficult to estimate the time and money saved by them in quick ship and plant repairs.

"While the outstanding lesson of the great war to our profession was the tremendous economic loss incurred by waiting for the war to build up an American marine, architects and engineers learned other lessons as well. The great value of standardized design, not only of simple cargo vessels but of destroyers, for instance, as well, was clearly demonstrated as never before. Men were trained in remarkably short time to perform all of the simpler operations connected with the building and operation of ships.

"On the whole, the character of work in the new steel vessels has been better than could have been reasonably expected under the conditions. At the present time probably half the men engaged in shipbuilding during the war have been laid off. There will be a further inevitable decrease in shipbuilding due to lack of new orders and the equipment by the Government of practically all Navy Yards to do building, both large and small.

"When prices have fallen sufficiently to attract orders from owners there will probably be a number of new orders, but not enough to keep busy half of the yards in the country. At the present time the Shipping Board has many more vessels of certain types than can be operated successfully. It is believed that the most important thing that can be done at this time for the merchant marine is to have the Shipping Board filled up to full strength so that it can function as originally intended, and make such reports and recommendations to Congress as may in its judgment be necessary to provide and operate a merchant marine. Legislative action may not be entirely agreeable to others well entrenched in the business, but probably no other action with the result of giving us our fair and permanent share in the carriage of our own goods would be much more agreeable. While this society was founded to promote and foster the art of shipbuilding, it must be remembered that there must be something to practice on if the art is to live with us, and I, for one, do not believe we will ever have a merchant marine without some form of protection.

"A cause of congratulation to all Americans interested in shipping has been the growth, particularly during the past year, of the insurance organizations in connection with our business, of a classification society destined to become great, and of American branch banks in many parts of the world. These are all essential and component parts of our commerce and necessary to the proper development of a merchant marine. On the whole, a great work has been done in starting our citizens again upon the sea and interesting many responsible Americans in ships. If the operation of American ships is reasonably profitable, there will be no lack of men or money."

University Education in Ship Construction and Marine Transportation

BY PROFESSOR LAWRENCE B. CHAPMAN

ABSTRACT

As a contribution to America's merchant marine, a course in naval architecture has recently been inaugurated at Lehigh University along lines widely different from other university courses. In the scheme of studies the course follows generally the engineering courses at Lehigh, except that business administration subjects have been made prominent. In introducing these new subjects to the curriculum we have not slighted in the least the basic engineering studies. We have, however, dropped out much of the advanced specialized work often included in courses in naval architecture.

The first year is practically no different from other engineering courses and needs no comment.

In the second year a study of ship construction, consisting of class and drawing room exercises, is begun. This course is given here to familiarize the student with ships and ship construction early in his course and to prepare him for the summer work to follow at the end of the second year. Following the sophomore year the student is required to spend at least eight weeks in a shipyard on hull construction. Lehigh is probably one of the first universities, outside of those giving co-operative courses, that requires this practical summer work as a requirement for the degree. A second summer's work of eight weeks is required following the third year. This summer is, if possible, spent at sea. Special attention is given to electrical engineering on account of the growing importance of electricity on shipboard for propulsion and auxiliaries. The course in naval architecture during the third year is given over mostly to the powering and propulsion of ships. The course in marine engineering is given over mostly to a detailed study of propelling machinery and auxiliaries. During the next few years a large proportion of the time devoted to this course will be given over to Diesel engines.

The study of ship design is begun in the fourth year. Here each student carries through a design for assigned conditions, selecting the proper dimensions, coefficients and displacement for assigned speed and deadweight and works up the lines, estimated weights, etc. A fair amount of attention is devoted to structural details in the senior year, but the main point desired is to have the student grasp the whole problem of ship design. A thorough knowledge of details and methods of construction can only be acquired by actual experience in the shipyard.

Both here and throughout the college course special attention is given to the economic features of ship design and operation. A study is made of operating expenses to emphasize the importance of detention on annual profits. In steam engineering, types of machinery and fuel for the most economical performance of the ship in service are given particular emphasis. The business training given, which is an important element of the Lehigh course, is handled by the College of Business Administration.

Subjects given in the second and third years are preparatory for special courses in marine insurance, foreign exchange and foreign trade given in the fourth year.

The aim of the course, in conclusion, is threefold: First, to turn out men who may in the future become specialists in naval architecture or marine engineering; second, to graduate a type of man who, after devoting several years to engineering work along marine lines, will be prepared, when the opportunity arises, to enter executive positions in the shipbuilding and shipping fields; third, to prepare men to enter the business end of shipping directly upon graduation.

DISCUSSION

This paper having the first place on the list had also the widest and most interesting discussion, it being recognized

that the technical colleges of the country are the recruiting field for the profession of naval architecture and that many practical shipbuilders and managers are likely to come from them.

Naturally there were two groups of members who took part in the discussion, those who are in the business of shipbuilding and desire to get well trained men, and the professors who desire to furnish them. Though there was considerable difference of opinion concerning the paper and also concerning the general matter of education, there was a general concurrence of opinion that whatever else the college does or neglects to do, one thing it must do, namely, give a sound, well rounded training in general engineering, together with instruction in the theory of shipbuilding.

Taking conditions as they are with our preparatory schools and high schools, and the fact that the course in a technical college is in practice restricted to four years, the college cannot expect to do much more than this agreed minimum; and that is where the chance for discussion comes, i. e., what else shall be taught in the limited time? Professor Chapman proposes to give considerable time to economics, accounting and business management and an inspection of his paper shows how he accomplishes his purpose. He also claims that his course differs from all others in this regard. The professors from other colleges could not let this pass unchallenged and the discussion was opened by Professor George F. Crouch, of the Webb Institute of Naval Architecture (formerly Webb Academy) who recognized the growing importance of some consideration of management and executive functions in school, but was of the opinion that it is enough to give an introduction so that students shall not fail to know the importance of these matters. As for accounting, he thought the student interested should be able to find instruction elsewhere as many courses are now offered. He also reported the custom at Webb Institute of requiring three full summers of work in shipyards and elsewhere.

Stevenson Taylor, president of Webb Institute, and known to all for his wide and varied experience in practice, explained why the name of the Institute had been changed to avoid misunderstanding and why the Institute does not find it advisable at this time to meet the requirements of the state Board of Regents and does not now grant degrees though the course in naval architecture is considered to be equal to the best. Speaking both as an educator and as a practical naval architect, Mr. Taylor considered that a sound fundamental education is the first essential and that students may be expected to do something themselves for widening their education.

Following a line of thought rather than the order of the discussion, we will give the opinion of Professor Sadler, of the University of Michigan, that there are fashions in education as in other things, and that, while now the fashion is for management, there is a tendency to return to the old fashions. At one time forty alumni were asked to suggest changes in the course in naval architecture, with the result that each proposed some specialty in which he was interested and that ten years would be required to teach them all. Provision for specialties is made by leaving half the senior year for options so that a student may choose management, advanced engineering or what not.

W. T. Bonner stated that the Drexel Institute, which is breaking away from the status of a trade school, now offers a course in naval architecture.

Walter M. MacFarland, who had served as assistant professor at Cornell while attached to the engineers corps of the navy, gave his opinion that four years at a good technical college gave as much education as could be acquired in twenty-five years by oneself.

All these speakers were or had been engaged on the educational side and might have their own bias on that account; the other speakers were free from that influence and their

opinions are most interesting. H. F. Norton, of the Newport News Shipbuilding and Dry Dock Company, delighted all the teachers by promising on behalf of his company to give ship drawings freely; when a student he felt the lack of such drawings, then more difficult to obtain. He was of the opinion that the colleges need not worry concerning the production of executives; the yards would develop them. C. F. Bailey, engineering director of the Newport News Shipbuilding and Dry Dock Company, thought it a good idea to let the young men grow up by their own endeavors. Man does not live on his reputation, but by making a reputation.

Launching of Ships in Restricted Waters

BY LIEUTENANT-COMMANDER H. E. SAUNDERS, C.C., U.S.N.

ABSTRACT

At the last meeting of this Society there was presented by the writer a paper dealing with methods employed to check the speed of vessels during launching, with particular reference to a type of friction launching brake developed and used at the Mare Island Navy Yard. A brief description of the launching and checking arrangements for the battleship *California* were given, together with a description of certain model experiments conducted in connection with this work. At the time this paper was submitted, however, the launch of the *California* had not yet taken place and it was proposed to submit a second paper, in the present form, embodying a description of the launch and an analysis of the data obtained at that time.

Before proceeding to a detailed account of the launch, which took place on November 20, 1919, it may be well to note the principal characteristics of this vessel, as bearing upon the data set forth in the following paragraphs:

Length overall	624 feet
Breadth overall	97 feet 5 $\frac{3}{4}$ inches
Mean draft at launching.....	14 feet 9 $\frac{1}{4}$ inches
Launching weight complete, with cradle.	14,610.5 tons
Pressure on ways, per square foot.....	2.4 tons
Mean declivity of ways.....	11/16 inch per foot
Maximum velocity attained.....	24.7 feet per second
Velocity when brakes were applied.....	21.5 feet per second

In order to obtain data for a complete analysis of the launching, every effort was made to provide sufficient recording apparatus for all phases of the operation. In addition to the standard drum chronograph previously employed at this yard, a second "direct-reading" chronograph was fitted and both machines connected to the ship by wires which were laid out over the ground ways.

Before proceeding to a description of the behavior of these brakes, it will be of interest to note briefly the organization of the special brake detail and the instructions issued for the guidance of the members of this detail. It has already been stated that there were three full rehearsals of these operations prior to the launch and that all the men were given an opportunity to watch the performance of the launching model, when specially rigged with cables and chains.

The two groups of men operating the hand pumps were directly in charge of a supervisor on each side, who was to superintend the operation and the emergency release of the brakes on that side. It was conceivable that, in the event of a wire cable stranding or kinking, or part of the brake gear carrying away, it might be necessary to release the pressure in one or more sets of cylinders to avoid serious damage.

The brakes were to be set as soon as their respective cables began to pull through (for the brakes Nos. 3, 4 and 5, port and starboard, this would occur at about 568 feet travel). As an additional signal, two large klaxons were to be sounded by the brake control officer at the head of the slip when the ship had run the proper distance and the chain cables had straightened out.

In case the speed of the vessel had not been sufficiently checked at 1,000 feet travel (under normal conditions the

vessel should have stopped dead in the water at about 960 feet travel), emergency pressure, 1,150 pounds per square inch, was to be applied, the signal for this pressure to have been five or six short blasts of the klaxons. When the vessel had stopped dead in the water, the brakes were to be quickly released upon signal of the klaxons, to prevent the strain on the cables from drawing the vessel back toward the slip.

The chain cables attaching the friction wires to the ship were flaked down on the floor of the slip so that each chain was clear of the others and separated from its own parts. The tumbling shores, of course, had to remain until the vessel was released, and, although they were directly in the path of the chains, there was no interference and very few of the timbers were thrown about.

From the moment that the vessel was released until she reached 648 feet travel, everything functioned exactly as was planned. At about 560 feet travel the chain cables began to straighten out, and at about 570 feet travel the klaxon signal was given to apply normal pressure on brakes Nos. 3, 4 and 5. Within less than one-half second the operators began pumping on these brakes, and the first application of pressure was sufficient to straighten out the chain cables. The brakes smoked considerably from the start, due to the fact that there was a protective coating on the wire cables of some fish oil preparation, which burned off on the outside of the strands as soon as the cables began to slide. At about 620 feet travel the cables straightened out on No. 1 and No. 2 brakes and normal pressure was applied by the operators.

At 648 feet travel, after the wires on No. 3 port brake had gone about 80 feet through the blocks and a pressure of 500 to 600 pounds per square inch had been applied to the rams, the chain cable on that brake carried away several feet from the pad on the ship's side. The vessel by this time had left the ways and was traveling at a velocity of about 19 $\frac{1}{2}$ feet per second. At 660 feet travel the chain cable on No. 5 port brake carried away about 420 feet from the ship's side.

One by one, as the pressure on the brakes was increased, their respective cables parted, about half of the chains remaining intact when normal pressure was obtained. At 776 feet travel all chains except No. 1 port had parted; at 780 feet one of the links connecting the outside wire on No. 1 carried away and the inside wire continued to pull through the brake. At 902 feet travel, as soon as this pressure had been applied, this chain cable also parted and the vessel was then running freely with the exception of the pieces of chain dragging along from the pad eyes. The starboard and port anchors were then dropped and the vessel brought to rest as described elsewhere in this report.

Port No. 4 brake was dismantled and opened for inspection immediately after the launching. The wires had traveled about 100 feet through the blocks, but there was no rifling and comparatively little scoring of the grooves. The leading end of the grooves showed practically no wear; the trailing end showed discoloration on the tops and bottoms of the grooves about half an inch wide and 20 to 24 inches long. The concentration of pressure and the resultant generation of heat were almost sufficient to make the metal soft enough to flow. The same condition on the other brakes indicates that the water cooling features of the brake must be improved somewhat and that the cooling must be most efficient where the greatest amount of heat is generated. The operation of all other parts of the brakes left nothing to be desired.

Six of the broken links from the ten chain cables were recovered, and every one showed either faulty weld or very inferior structure. The fact that two of the cables broke before 600 pounds pressure had been applied to the brakes proves that neither excess load nor sudden application of load was responsible for the failure of the chains in this instance. Chain cables for this purpose are considered treacherous and unreliable and far inferior, except for ease in flaking down, to wire ropes with suitable end fastenings. They have not

been used in the past at this yard, and they will not again be used in the future. Although in this case the absolute failure of these chains to stand up to their work introduced some unforeseen complications, it is considered that the results, taken all in all, most fully justified the modifications which had been made in the original design of these friction brakes.

Aside from the question of chain cables, the functioning of the hydraulic brakes was, on the whole, so satisfactory that they will be retained in practically their present form for use on the battleship *Montana*, now under construction at the Mare Island Navy Yard. Two additional brakes are to be fitted, making a total of twelve. Although the probable launching weight of the new battleship is almost 50 percent greater than that of the *California*, or about 20,000 tons, the necessary retarding effect is to be obtained by increasing the braking period, making use of the greater part of the channel fairway instead of attempting to stop the vessel in about 350 feet. Wire connecting cables, secured to pad eyes and lashed with small rope stops to the ship's side, will replace the former chain cables laid down on the slip, and the friction cables will be laid out in pipes or boxes instead of being wound on reels.

It must be remembered, however, that the tests were carried out with the limited means then at hand, which permitted only a comparatively short pull on one friction wire at a rate not exceeding about one-half foot per second. It must be remembered also that the tests were conducted with only two cables, which presented clean, bright surfaces to the brake blocks on most of the runs. The friction cables in place at the time of the launch, however, were covered with a partly oxidized coating of heavy oil, just as they had been delivered by the contractor, and the presence of this oil coating may possibly have reduced the friction by an appreciable extent. It appears quite likely, therefore, that at the speeds and temperatures at which these brakes run during a launching operation there is a considerable reduction in the assumed coefficient of friction, although the data given above are unfortunately neither sufficiently accurate nor extensive to fix this value within very close limits.

DISCUSSION

This paper was illustrated by moving pictures of the preparation for launching, of the christening by the fair sponsor, of the motion of the ship down the ways, and of the breaking of the chains which checked the ship, and finally of the ship aground across the channel. Hugo P. Frear, naval architect of the Bethlehem Shipbuilding Corporation, called attention to the fact that the Union Iron Works regularly launches ships across the channel and onto the mud flats. Captain J. H. Linnard, U. S. N., spoke approvingly of the devices described in the paper, especially as the increase in length makes stopping of the ship in a short space increasingly important. On the other hand, William Gatewood, naval architect of the Newport News Shipbuilding and Dry Dock Company, was of the opinion that the declivity was too great and that with just sufficient declivity to insure that the ship would clear the ways ordinary methods of stopping would suffice.

THURSDAY AFTERNOON SESSION

New 20,000-Ton Tankers

BY HAROLD F. NORTON

(This paper is published on page 970.)

DISCUSSION

The interest of this paper is largely in the presentation of methods of meeting difficulties of construction in new tankers of great size, this one having a displacement of 20,000 tons, and being alleged to be the largest yet built, and having the largest Scotch boilers. Both these claims were questioned by

Hugo P. Frear, who humorously claimed that his company had built ships that could be called 40,000-ton ships; these were designed to carry oil to Chili and bring back ore, being specially constructed for that purpose. As shown by the author, the pump room is the same size as an oil tank, giving simplicity of construction and also, as Mr. Frear pointed out, improving the distribution of weights which in this type of ship is likely to be concentrated amidships; there have been certain casualties due to such overconcentration. D. H. Cox raised the question whether there was any real economy in the use of a straight sheer, especially as it affects the allowed freeboard.

In the author's reply the most important item was the explanation that the provision of voids amidships to improve the weight distribution, though well understood by naval architects, is difficult of accomplishment because the owners are influenced by their captains, and the captains are unaccustomed to voids in that locality; voids near the ends are more familiar to them.

Economical Cargo Ships

BY ALFRED J. C. ROBERTSON

This paper is a continuation of the valuable investigations which were reported by the author at the 1919 meeting of the Society. The extensive study of full form cargo vessel models at the experimental basins in Washington and at the University of Michigan indicates the direction in which designs may best be developed in the future. The complete paper is published on page 990 of this issue.

DISCUSSION

As explained in the paper, the information concerning resistance is extended into a field not covered by previous investigations at experimental basins, which have been largely employed on naval and fast passenger steamers. Professor H. C. Sadler, who is in charge of the experimental basin at the University of Michigan, where these investigations were made for the Shipping Board, was able to give valuable supplementary information. The society was pleased to learn that another series of experiments is under way, which, like the present series, will be available for the profession. The various series on full bodied models brought out some unexpected results; for example, in at least one case a smaller prismatic coefficient was accompanied by greater resistance, which is contrary to the usual idea.

Professor Sadler explained also that discrepancies between results from different experimental basins were usually due to differences in conditions. At one time he towed a model of a submarine at Ann Arbor after it had been towed at Washington, taking care to have the conditions identical; in this case the comparison of results was satisfactory. E. H. Riggs, naval architect of the New York Shipbuilding Corporation, confirmed the fact that fuller bodies did not always mean harder driving; in a specific instance the removal of 200 tons from the bow of a ship to get finer lines did not improve the resistance. He referred to the inconvenience that arises from the fact that results from various basins are expressed in different forms, each of which had to be learned and could not always be reconciled; the present paper aids in overcoming this difficulty. Professor E. M. Bragg, of the University of Michigan, conveniently summed up the situation, as it now appears, by saying that for a full bodied ship having a speed ratio of 0.5 to 0.6 the distribution of displacement should be 28 percent for the entrance and 42 percent for the run. There is also the apparent anomaly that at very low speed the entrance should be longer in proportion to the run; at higher speed the entrance may be decreased, but with continued increase in speed the entrance must again be increased. The penalty of making entrance and run of equal length, as is commonly done, can be given as 10 percent increase in power.

Notes on Rivets and Spacing of Rivets for Oiltight Work

BY HUGO P. FREAR

ABSTRACT

The present high state of efficiency of the modern tanker leaves little to be said on rivets and rivet spacing for oiltight work that would be both new and conservative, and it may safely be said that radical departures from the practice arrived at as the result of years of experience would invite trouble. Riveting is unquestionably one of the greatest, if not the greatest, item of expense entering into the cost of construction, and the unprecedented demand for tankers and oil burning vessels at this time magnifies its importance.

Rivets and spacing of rivets for oiltight work, as covered by the classification rules, Navy Department, British Admiralty, etc., do not vary radically, although, on account of higher stresses used, a greater spacing is adopted in some parts for naval vessels. It must be borne in mind, however, that naval vessels are not subject to the great variations in load encountered in the merchant marine, and therefore the stresses can be anticipated with greater accuracy.

Rules for rivets and rivet spacing are the result of evolution arrived at by rule of thumb, experience, size of rivet found practicable to drive, spacing suitable for calking, experiments, calculations, survey reports on damage cases, etc., and are in the opinion of the writer generally satisfactory.

Oil tightness depends, perhaps, more on good workmanship than any other one thing, especially so far as riveting is concerned. If every rivet could be guaranteed 100 percent perfect, slightly greater spacing would be practicable and might be allowed by classification societies except where a given efficiency of joint is essential.

While there were probably some barges in existence prior to 1872, it was in that year that the first bulk oil carrying steamer was built at Palmer's, Newcastle-on-Tyne, England. Although this vessel was built especially for carrying oil in bulk, she had a double bottom, and the indications are that the rivet spacing was the same as in vogue at that time for watertight work.

During this period the spacing of rivets, even for watertight work, was in some respects greater than at present and vessels frequently leaked a little when new, but they were built of iron and the joints soon rusted up tight, thereby increasing the friction of the riveted joints and resulting in stronger and more durable vessels under existing conditions. This rusting-up process, however, would not take place in the case of new vessels built to carry crude or lubricating oils in bulk, and on that account some of the converted vessels were tighter than new tankers.

Oxidation, however, takes place in tanks carrying gasoline, and this rusting up process, undoubtedly, penetrates into the seams. On this account it might be beneficial to carry a cargo of this character on the first voyage or two as is sometimes done.

Up to 1894 there were built or building to Lloyd's Class sixty-four tankers, yet the Society did not consider that it had sufficient experience to lay down definite rules for their construction. In this year, however, Benjamin Martell, chief surveyor to Lloyd's Register, read a paper before the Institution of Naval Architects wherein he outlined his views on the details of construction and of riveting for bulk oil carriers, recommending three diameters for oiltight work. Within a comparatively short time after this, Bureau Veritas, apparently profiting by this paper, published rules for tankers, and the American Bureau of Shipping published their first rules in 1902, but the first rules of Lloyd's did not appear for general use until 1909. Both Bureau Veritas and the American Bureau recommended three and one-half diameters at the start, while Lloyd's specified one more rivet in a frame space than required for watertight spacing resulting approximately in three and one-half diameters.

Evolution was a slow process, and no doubt in numerous cases the true cause for failure was not recognized. Mr. Martell realized this when he wrote his paper and provided for tanks not over 24 feet in length increased stiffeners and brackets, as well as closer spacing of rivets. Had the earlier tankers been better designed as regards tanks, stiffeners, brackets and compensation, where needed, the question of rivets and spacing of rivets for oiltight work might possibly have received somewhat less attention during those troublous times. This appears to be a reasonable inference from the fact that so many converted tankers have since given long and satisfactory service.

That oiltight work should be double riveted was an accepted rule. This is still the general requirement, but single riveting is now permitted in the seams of double bottoms intended for carrying fuel oil. Lloyd's formerly recommended single double riveted bulkhead bounding bars but later gave the builder the option of using double single riveted bars. The general practice now is to use double single riveted bars with countersunk heads and points and bars calked on both flanges on each side. The writer is inclined to favor single double riveted bounding bars and pan head rivets in standing flange with calking on one side because it is believed this lends itself to cheaper and better workmanship and would insure the parts being drawn up more closely. Countersunk heads are, of course, unavoidable in the shell flange. Where double bounding bars are fitted, careful workmanship is necessary to insure the two shell flanges lining up perfectly for intimate contact. Conditions, however, would be substantially the same as with single bounding angles. Pan head rivets could be used except in one flange, three ply work would be eliminated, and only two edges would require calking. A single angle as recommended above would have the same number of rivets, the same amount of calking, and be more easily set.

In gunwale bars, Lloyd's require four and one-half diameters for watertight work and five diameters for oiltight work, which does not seem consistent. In a recent case, 1-inch rivets were spaced five diameters in a 5-inch by 5-inch gunwale bar for oiltight work and appeared to be too crowded for the width of flange and size of rivets.

The extensive use of oil for fuel in naval vessels during the last few years has brought up for consideration and settlement many problems in design which did not exist in coal burning vessels. In vessels of great length such as scout cruisers and battle cruisers, longitudinal bulkheads are used as strength members. The riveting connections in these bulkheads must be designed to obtain maximum strength, and therefore the riveting should not be so closely spaced that more material is punched out of the plating than allowed in the calculations, without compensation. If, however, these bulkheads form boundaries of oil tanks, it becomes a matter of importance, when transverse bulkheads join the longitudinal strength bulkheads, to avoid too close spacing in the bounding bars. If the strength bulkhead is designed for a spacing of six diameters for rivets in stiffeners and oil tightness demands five diameters at a transverse bulkhead, it becomes necessary to introduce compensating liners which add to the weight and, on account of the extra thickness of plating, increase the difficulty of making the structure tight.

The hull division of the Philadelphia Navy Yard recently made a test on an experimental box to determine if a six diameter spacing of rivets would be satisfactory under the conditions as stated above. Six diameters might be quite suitable on a deck near the neutral axis but unsuitable for parts subject to stresses resulting from the vessel working in a sea-way or from shocks of gun fire or explosion. In this test it was found that the calking of bounding bars to heavy bulkheads was satisfactory under a 60-foot head with a six diameter spacing in the connection of transverse to longitudinal bulkhead and five diameter spacing in bar connecting to the shell.

A similar tank was also recently tested at the New York Navy Yard to demonstrate the efficiency of six diameter spacing for T-bar stiffeners and for bounding bars to bulkheads. The tank was first subjected to a test head of 65 feet of water and found to be tight; then to a twenty-four hour endurance test with oil at the same pressure. Then the pressure head was increased to 93 feet, which pressure was maintained for four hours without leaks.

One of the larger builders, as a result of mathematical analysis, has suggested the following spacing as permissible, provided that considerations other than oil tightness did not determine the spacing:

TABLE I.—PROPOSED SPACING OF RIVETS

Diameter of Rivet, Inches	Thickness of Plating, Inches	Spacing in Diameters
$\frac{3}{4}$	$\frac{5}{16}$	3.6
$\frac{3}{4}$	$\frac{3}{8}$	4.2
$\frac{7}{8}$	$\frac{1}{2}$	4.9
1.....	$\frac{3}{4}$	5.6
$1\frac{1}{8}$	1	6.3
$1\frac{1}{4}$	$1\frac{1}{4}$	7.0

The above spacings were based on the supposition that $3\frac{1}{2}$ diameters were satisfactory for a 10-pound plate using $\frac{5}{8}$ -inch rivets, and assuming that the deflection of the plate edge caused by calking probably varies as the ratio of the fourth power of the distance between rivets to the fourth power of the thickness of the plating, and that the extension of the rivet varies as the ratio of the distance between rivets to the area of the rivet.

A naval constructor stationed at the same yard carried the investigation further by considering the deflection that is caused by calking and by the amount of general deflection of plating due to water pressure, and suggested that based on the assumptions made the following spacing would be satisfactory: 15-pound plate, 4 diameters; 20-pound plate, 4.5 diameters; 25-pound plate, 5 diameters; 30-pound plate, 5.3 diameters; 35-pound plate, 5.6 diameters.

The analysis used in deriving the above tables of rivet spacing for oiltight work was made to confirm a theory that every unnecessary rivet is a possible source of leakage, and that for heavy plating a wider spacing would be permissible but considered only the stresses on the plating and rivets due to calking to the exclusion of the more complex stresses experienced under service conditions. If the spacing suggested in the above tables is suitable for oiltight work, it might be necessary to increase the number of rows to insure proper strength and friction of the joint, in which event there would be an increase in weight and the attempt to reduce the number of rivets defeated.

DISCUSSION

The discussion of this paper, like the paper itself, presented a mass of important information concerning allowable practice in riveting for oiltight work. Much of the discussion was written and, again, like the paper, it was difficult fully to appreciate the numerous details disassociated from concrete examples. The paper and the discussion will be a mine of information to those who need it and who will be ready to take the trouble to consult the transactions of the society for that purpose.

FRIDAY MORNING SESSION

Comparative Tests of Bilge Keels and a Gyro Stabilizer

BY COMMANDER WILLIAM MCENTEE, C.C., U.S.N.

ABSTRACT

In recent rolling experiments carried out at the United States experimental model basin on a model of the *Langley*, the results obtained are believed to be of sufficient interest to

naval architects to warrant making them the subject of a paper for this Society. Incidentally there is shown one of the purposes for which the wave-making equipment at the model basin is employed.

The experiments had for their object a comparison of the quenching powers of bilge keels and of a gyro stabilizer so far as may be determined by model tests. As the *Langley* is being refitted to carry aeroplanes which are both to fly from and to land on her deck, it appears that the prevention of excessive rolling is a matter of greater importance than for other vessels.

For use in the tests a small gyro stabilizer was obtained from the Sperry Gyroscope Company. This was an exhibition stabilizer, and as it was not designed especially to suit the model it was larger than necessary. Also the speed of the precession motor was not well adapted to the period of the model to give most efficient results. The designed stabilizing moment of the twin gyros when running at 7,000 revolutions per minute is 57.4 pound feet, but during the tests the speed was cut down as far as possible to about 2,300 revolutions per minute, reducing the stabilizing moment to about 20 pound feet.

The dimensions of the *Langley* are: Length, 520 feet; beam, 65 feet; draft, 16 feet, and 11,000 tons displacement. The model to $1/26$ th scale was first fitted with bilge keels, representing to scale, keels 15 inches deep by 180 feet in length and rolled in still water to obtain its declining angle curve. The bilge keels were then removed and another declining angle curve obtained. Without bilge keels to reduce the angle of heel from 11 degrees to 3 degrees required about 54 swings as compared with 8 swings with bilge keels.

The model was next rolled with and without bilge keels and with the gyro stabilizer in waves. For this purpose it was held broadside to the waves by single head and stern lines made fast to the model at the waterline close to the longitudinal rolling axis. The height and period of the waves could be controlled within limits and could be so adjusted as to produce marked rolling. In the same system of waves the bilge keels reduce the arc of roll from 26.4 degrees to 9.6 degrees, or about two-thirds, while the gyro stabilizer reduced it very quickly when cut in, from 34 degrees to 3 degrees or to about one-eleventh of the uncontrolled roll.

The model was then tested in waves approaching half the period of the model. With the bilge keels in place, when the wave length was shortened so that the rolling was no longer synchronous the model stopped rolling almost entirely, and no other wave period could be found that would induce rolling to any extent. When the bilge keels were removed, however, it was easy to find a period of wave in the vicinity of the half period of the model that would cause very heavy rolling. The angle rolled through was so great that it was necessary to use a shorter arm for the pencil of the gyroscopic roll recorder, thus changing the scale for angle of roll on the records and running up to at least 48 degrees. When cut in, the stabilizer almost instantly cut down the maximum roll to about 2 degrees.

As it was apparent from the preceding tests that the roll quenching capacity of the gyro stabilizer was more than ample for the model, an investigation was next made to determine its performance, without bilge keels, in higher waves, the higher waves being obtained by increasing the eccentricity of the wave maker while attempting to keep the period of the wave such as to produce maximum rolling.

The estimated stabilizing moment of the gyro stabilizer as run during the experiments was 20 pound feet. This was the minimum stabilizing moment which could be obtained because the gyro motors could not be run at any lower speed. To compare the estimated stabilizing moment with a known impressed moment, additional tests were made in which the stabilizer was operated against a rolling moment produced by a weight moving harmonically from side to side in the model

through a distance of 8 inches. By controlling the speed of the motor it was possible to make the harmonic rolling moment agree with the natural period of the model. By varying the weight it was possible to increase or decrease the rolling moment. With a maximum rolling moment of 31.33 pound feet, the gyro stabilizer reduced the roll from 37.5 degrees to 3 degrees.

It is to be noted, also, that it required several rolls before the angle was so reduced. When the rolling moment was increased to 39.33 pound feet the roll was reduced by the gyro stabilizer from 46 degrees to 5 degrees, though taking a somewhat greater number of rolls to do so. When still further increase in the rolling moment was made to 47.33 pound feet the capacity of the gyro stabilizer was clearly insufficient to cope with the same, the roll being reduced from 42 degrees to 34 degrees only.

As a final test an investigation was made of the increase of towing resistance of the model when caused to roll by an harmonic rolling moment applied to the model while being towed in smooth water. The results obtained were reduced to effective horsepower curves for the ship. From these it appears that at a speed of 15 knots the effective horsepower would be increased from 3,000 to 3,300 when the ship is rolling through an arc of 25 degrees, and to 3,600 when rolling through an arc of 45 degrees, corresponding to an increase in effective horsepower of 10 percent and 20 percent respectively. It is to be noted that this does not include the loss of power due to decrease in propeller efficiency for a twin screw ship, when the propellers alternately approach the surface, if not actually coming out of the water.

These results confirm experience at sea that loss of speed is found to occur when ships are rolling heavily. Under these circumstances it appears that the power and weight devoted to the means for stabilizing a ship are more than amply repaid by the saving effected in the power required to drive her.

DISCUSSION

This is the first article published since a wave-making apparatus was established at the Washington experimental basin and is therefore most interesting and important. The author pointed out that 20 foot pounds of stabilizing moment by the gyroscope were able to cope with a wave which had a maximum of 36 foot pounds of rolling moment.

Taking up first certain questions and answers together, which of course were separated in the discussion, the author explained that experiments on towing models among waves did not yield information concerning the influence of yawing on resistance, nor the difference between single and twin screws. It is expected that trials in prospect on the *Anderson* with and without stabilizers will answer these questions. The author further agreed with Professor Sadler that the effect of rolling at sea, as shown by a year's work compared with model experiments, was a loss of 10 percent in speed; in other words, this can be expressed as a demand for 30 percent more power for the same speed. Homer Ferguson, president of the Newport News Shipbuilding and Dry Dock Company, said that the trial speed was usually made to show a knot more than was expected in service.

Elmer Sperry, president of the Sperry Gyroscope Company, added to the interest by giving supplementary information. In the first place he said that his provisional computation of losses in speed due to rolling were so large that he cut them down to a fraction before reporting them, but that these experiments show his estimates to be fairly correct. He emphasized the fact pointed out by the author that the model in the basin could not yaw and had no helm, and so no report could be made on such influence on resistance. A very important matter is shown by these experiments on rolling, i. e., that a stabilized ship does not ship seas; this was predicted by Sir William White many years ago. Mr. Sperry further

emphasized the rapid action of the stabilizer as compared with bilge keels; he pointed out that, like the poor, the ship always has its bilge keels with it, while a stabilizer need work only when required.

Surface Condensers

BY LUTHER D. LOVEKIN

ABSTRACT

In the earlier days, when the old reciprocating engine held full sway, it was useless to consider high vacuums, as there was no economy to be had by the use of a high vacuum on account of the large volumes of steam to be cared for. In other words, any vacuum above 25 inches really proved to be a loss rather than a gain as one might expect, due to the design of the ordinary reciprocating engine.

The stationary engineers of the world, with the wonderful research laboratories at their command and the further advantages in being able to make exhaustive tests on actual installations, undoubtedly led the way for improving vacuum and also for taking care of other losses incident to high vacuum, and the marine engineer has been, and should be, content to profit by their experience in developing means for insuring high vacuum under decidedly different conditions.

Items that the marine engineer has to consider seriously are weight and space, so that what might be good engineering for stationary practice in condenser design would be impossible for marine practice. I refer more particularly to tubes above $\frac{7}{8}$ inch in diameter being used; in fact, all condenser tubes for marine work are practically confined to two sizes, namely, $\frac{5}{8}$ inch and $\frac{3}{4}$ inch outside diameter.

Apart from the design of condensers for steam turbines, marine engineers have shown little interest in designs for surface condensers, and even at the present time we find many engineers specifying condensers having so many square feet of surface per horsepower and a certain size of tube, with no regard whatever for the principal features of condenser design, such as velocity of water and the tube length necessary for extracting the British thermal units in the steam. Some figures and designs are here given which are the result of much thought on the problem of surface condensers.

During the years of 1907 to 1910 the author made some very interesting and instructive tests in heat transmission for various purposes. These were followed by numerous tests on the same apparatus by the Engineering Experiment Station at Annapolis, Md. In 1915 he made a series of tests on single tubes, $\frac{5}{8}$ -inch outside diameter, placed inside of tubes of varying diameters. With a $\frac{5}{8}$ -inch tube, about 4 feet long, placed inside of a tube about $1\frac{1}{2}$ -inch inside diameter, a temperature rise of 60 degrees F. was obtained. By placing this same $\frac{5}{8}$ -inch tube inside a tube 2-inch inside diameter, a temperature rise of 100 degrees F. was obtained with the same steam pressure and the same conditions of test. This showed conclusively that the steam space surrounding the $\frac{5}{8}$ -inch outside diameter tube was a most important factor.

The author then ran a series of tests with varying velocities of water and obtained a heat transfer of about 2,750. An apparatus was then built having about one hundred tubes, $\frac{5}{8}$ -inch outside diameter, with the conventional tube layout, and this apparatus was tested exhaustively by the engineers at the Annapolis station in both vertical and horizontal positions, these results showing a heat transfer of about 1,000. This clearly proved the advantage of having ample steam space between the tubes, so it was decided to design a surface condenser with tubes spaced well apart at the entering rows and to gradually decrease this spacing to normal at the point where the condensate left the tubes.

The experiments on the various appliances showed that it was a serious mistake to fill up an enclosure with as many tubes as it could hold. Why not endeavor to produce a design whereby a maximum inlet area between the tubes could

be obtained, so that with a volume of steam corresponding to a vacuum of $28\frac{1}{2}$ inches we would have a velocity of about 100 feet per second or less? Instead of the method of permitting this steam to travel through a bank of tubes after it had already been condensed and allowing the cold circulating water to cool the condensate, it was decided to reduce the depth of the bank of tubes to about half of that ordinarily used and to permit the condensate to be drained from the bank of tubes at its maximum temperature, "which should be approximately that of the temperature corresponding to the temperature of the vacuum."

Realizing the great value of reducing the volume of air and non-condensable vapors, a liberal cooling chamber was provided of efficient form. When used for battleships or the like this air cooling space was enlarged, thereby providing about 40 percent of the total tube surface. This enabled the outer portion of the condenser to serve as a primary condenser and the so-called air cooling space a secondary condenser.

Thus, when the turbines are operating at less than full load the primary condenser can do all the work and retain its heat in the condensate instead of falling over a bank of tubes equal to about one-half the diameter or depth of the condenser, for no other purpose than to reach the bottom of the condenser so it can be drained off by the pump. Draining the condensate off in stages after it has been condensed appeared to be more rational, and the test data confirm this belief.

It has long been known that infiltration of air through cast iron condenser shells is the source of great trouble and annoyance with high vacuums. In order to reduce this to a minimum we made tests without any coating on the shell, then with one coat of bitumastic enamel, and finally with two coats of enamel. The effect of the final coat was an improvement of nearly 1 inch of vacuum under the same conditions.

Particular attention is called to the air channel way in these condensers, it being formed of two plates running the entire length of the space between the tube sheets, these plates being spaced apart and having their sides perforated with small holes over the entire plate. This is done so as to prevent any air pockets being formed in any part of the condenser. Where the condensate pump and air ejectors are used, such as on the proposed surface condenser for United States battle cruisers, it will be noted that the condenser head is cut away so as to clear the air ejector connection. This makes a very simple connection and yet prevents the air pipe being flooded with water. In order to ascertain the height of the water in the condenser shell, a water gage glass can be connected between the condensate suction pipe and the shell, which will readily show the height of the condensate, if any, within the condenser shell.

It is almost unnecessary to state that the design of a surface condenser for battleships and the like which are subjected to their maximum speeds for comparatively short intervals of time is an entirely different proposition from that of the merchant ships, where the maximum speed is run the greater part of the time. In a case of the battleships we can afford to force a greater amount of water through the tubes than we can in the case of a merchant ship, for the reason that the cost of pumping the water for the short time that these vessels run under their maximum conditions is more than offset by the reduced size, weight and space which can be obtained by using more water.

In conclusion, I wish to emphasize the fact that had the marine engineers of the world fully understood the principles of surface condenser design during the past twenty-five years as well as they do today the surface condensers for most of our reciprocating engines in the merchant service could have been built with from 25 to 50 percent less surface and still had the same reserve factor for dirty tube surface. This would have been a valuable conservation of both our physical as well as our natural resources.

DISCUSSION

The discussion brought what is evident from inspection of the paper that the tests on the condenser in service, which perhaps are the most important item in the paper, suffer as service tests commonly do when compared with laboratory tests in that it is difficult, if not impossible, to get ideal conditions; such tests, with due allowance for conditions, are nevertheless valuable. Further, it was brought out that ideal conditions for large heat transfer coefficients may not be profitable in that the cost of pumping to force a high water velocity in the tubes may more than offset the gain in thermal efficiency. One point, well known but frequently forgotten, is that the auxiliaries exhausting into the condenser deliver an appreciable amount of oil which fouls the tubes. (Query: Why not use electric auxiliaries and cut out this trouble?) The author, in reply to the criticism that he used well-known devices in designing his condenser, claimed properly that a competent assembly of such devices to make a good condenser had the elements of originality.

FRIDAY AFTERNOON SESSION

Rules and Regulations for Freeboard

BY DAVID ARNOTT

(This paper will be published in an early issue.)

DISCUSSION

This paper, which presents in convenient form the present condition of freeboard for seagoing vessels, did not call for much comment. The general opinion was that, while vessels navigating inland waters and coasting vessels should receive special consideration, there is little likelihood that either class would be much inconvenienced even though they were subjected to the rules for seagoing vessels, since the conditions of service ensure good freeboard. It was also generally regretted that the question of strength should be injected into governmental rules for freeboard; it was thought that the matter of strength might be left to registration societies.

Recent Advance in Oil Burning

BY ERNEST H. PEABODY

ABSTRACT

The United States Navy is again pointing the way to future development in oil burning. In co-operation with leading mercantile interests who are manufacturing equipment for the Navy, they are experimenting not only in the use of heavy viscous oil but are demanding larger units and greater individual capacity both in boilers and in oil burners. I predict that this increase in size and rate of forcing will mark the trend of future development in the merchant marine.

I am indebted to the American Bureau of Shipping for permission to use the following estimate of the number of oil burning vessels as compared to those burning coal:

TABLE I.—ESTIMATED FUEL ARRANGEMENTS OF AMERICAN OWNED

VESSELS		
	Vessels	Percent
Coal burners, approximately.....	993	37.8
Oil burners, approximately.....	1,260	48
Balance (mainly non-propelled).....	369	14.2
American vessels.....	2,622	

Thus, while very large vessels are using oil fuel successfully and from the estimate of the American Bureau of Shipping it is evident that nearly 56 percent of the present American self-propelled merchant fleet consists of oil burning vessels, it is probable that in not one of these ships is there a boiler containing more than 4,500 square feet of heating surface in the individual unit and no single oil burner capable of atomizing over 600 pounds of oil per hour, while the oil

burned per hour per square foot of heating surface under forced draft conditions will not equal one-half pound.

In other words, the present boiler and oil burner practice in the merchant marine is following closely along the very conservative lines of previous custom, and the full value of the use of oil fuel has not yet been approached.

The remarkable economy of the properly designed small tube express type watertube boiler at high rates of forcing with oil fires was demonstrated not very long ago in some notable tests at the Fuel Oil Testing Plant. The tests were conducted under the direction of Lieutenant-Commanders A. M. Penn and W. R. Purnell, United States Navy, and their staff of trained assistants. The boiler was of the White-Forster design, built by The Babcock and Wilcox Company, and contained 7,565 square feet of heating surface and 753 square feet of superheating surface, the furnace volume being 751 cubic feet. Three different types of air registers were used: The Bureau of Engineering forced draft design (of which there were sixteen units installed), the Bureau of Engineering natural forced draft design (eleven units), and what was then known as the Peabody register manufactured by The Babcock & Wilcox Company, designed for either forced or natural draft and of which there were also eleven units.

It will be noted that in the highest capacity test of June 10, 1919, there were eleven burners in operation, each atomizing 1,032 pounds of Navy standard oil (25.5 Baumé) per hour, giving a consumption of 1.5 pounds of oil per square foot of heating surface per hour. The evaporation of water per pound of oil from and at 212 degrees F. was 15.14 pounds, giving an evaporation of water per square foot of heating surface per hour of 22.73 pounds from and at 212 degrees with an efficiency of 76.15 percent. The air pressure in the closed fireroom was 9.5 inches and the rate of combustion per cubic foot of furnace volume reached the very high figure of 15.12 pounds of oil per hour. It is believed that this test stands as a world's record for efficiency at high boiler and furnace capacity.

Early in the past summer The Babcock and Wilcox Company offered six air registers of their standard design, but of an enlarged type, with mechanical atomizers capable of atomizing 1,500 pounds of oil per unit per hour. These were tested by Commander Purnell under the same White-Forster boiler already described. The six burners successfully sprayed over 9,000 pounds of oil per hour under conditions similar to those pertaining to the United States scout cruisers now under construction. The oil per square foot of heating surface was approximately 1.2 pounds, and the oil per cubic foot of furnace volume per hour about 12 pounds.

This record was exceeded in August in a test of the Normand boiler at the Fuel Oil Testing Plant. This boiler contained 4,500 square feet of heating surface and 487 cubic feet furnace volume and was fitted with three of the recently developed Peabody-Fisher wide range mechanical burners and new Peabody air registers. Crude Mexican oil of 13.3 Baumé was used and the three burners each atomized over 1,800 pounds of oil per burner per hour, without smoke, carbon or other objectionable conditions. The oil burned per square foot of heating surface was 1.2 pounds per hour and per cubic foot of furnace volume 11.15 pounds per hour.

A new record in oil per burner per hour was established on September 17 by Commander Purnell when three of the six Babcock and Wilcox units were tested, the burners being supplied with larger tips. The oil used was 19.9 Baumé. The test was of one hour duration but followed several hours' steaming, during which the individual burner capacity was pushed up to 2,000 pounds per hour. The record for the hour shows 2,238 pounds, while in the last half hour the rate of combustion per burner reached 2,287, a safe margin over one ton of oil per burner per hour.

It is worthy of note that six months ago fifteen burners were being considered for each of the sixteen boilers of the battle cruisers now being laid down. On the basis of this

last performance only five would be required, and seven would be a safe estimate. To develop 180,000 horsepower with 80 or even 112 oil burners is a very notable performance, but there can be no doubt about its being entirely possible with the equipment which has been perfected in this country.

I do not wish to be understood as saying that I think that oil burners atomizing a ton of oil per burner per hour will be immediately adopted for naval service, far less for the merchant marine, but the trend of modern development is certainly in the direction of larger units and the higher capacities made possible by the use of oil fuel.

Referring to the matter of flexibility, I think I am justified in discussing another recent development which I believe marks a distinct advance in the oil burning art. It is well known that the mechanical atomizer of the usual design has a decided limitation in range. Unlike the steam atomizer, it cannot be operated at low capacity if it is designed for a high one. The lower limit with the oil pressures ordinarily used is approximately one-half the upper.

In atomizers of the Thornycroft type, in which the size of the tangential channels may be reduced by an adjustment in the burner, the velocity through the channels is kept up to a large extent at low powers, and the range of these burners is much greater than in those of the usual type. But it has been found difficult in practice to make individual burner adjustment under service conditions, and this method has never become popular.

Another and radically new plan, however, has been devised which promises very satisfactory results. This consists of maintaining the whirling motion in the central chamber of the tip undiminished whatever may be the capacity desired of the burner; in other words, instead of delivering through the orifice all the oil which enters the burner chamber, as is invariably done in all other mechanical atomizers, a part of the oil supply is diverted or by-passed from the central chamber and returned to the pump suction, and the actual effective capacity or amount of oil which is sprayed into the furnace depends merely on the proportion of the oil that is by-passed to the total amount entering the burner. Thus, as the amount of oil entering the central chamber through the tangential slots remains at all times at the maximum, the whirling of the oil and the atomizing effect remains also at a maximum, so that a perfect spray is secured whatever the capacity, at low powers as well as at the highest rate. By this method the range of the atomizer is very greatly increased, and instead of being limited at the low powers to 50 percent of the maximum a good spray can be secured all the way down to about 10 percent of the total. This method of spraying is the invention of Commander J. O. Fisher, United States Navy, now fleet engineer of the United States Atlantic fleet. It is believed that the wide range in capacity will make the burner especially useful for fluctuating loads or in any installation where it is now necessary to change the tips or close off a portion of the burners.

It may be of interest to state that the burners having a maximum hourly output of 1,820 pounds which were tested at the Fuel Oil Testing Plant were successfully operated at 250 pounds, while smaller tips designed for a maximum of 800 pounds were operated at a minimum of 80 pounds per hour.

A matter closely allied to the use of oil as fuel, in which there has been no advance, and, if anything, a retrograde movement, is the measurement of the viscosity of oil.

It is probable that if the Saybolt viscometer had been obtainable by anybody outside the large oil companies ten or twelve years ago when the mechanical atomizer began to be used extensively, we should not now be using the Engler instrument at all in this country, notwithstanding its extensive use in Europe. But some method of determining viscosity became necessary and, as usual, the Germans were on the job and supplied us with Engler instruments. Various methods of interconversion of the two scales have been suggested, but

the problem is not as easy as it looks, as the conversion factor is not constant throughout the viscosity range and it also varies with the character of oil.

It is to be hoped that some international standard method of measuring the viscosity of oil will be adopted, reconciling the Saybolt, Engler and Redwood scales and eliminating the periodic appearance of new proposals for determining viscosity. Only then shall we all be able to speak the same language.

DISCUSSION

This paper gives an authoritative statement of recent progress in oil burning by one who has taken a leading part in its development; there was a most flattering acknowledgment of this fact by Admiral Dyson for the Navy and by John Martin on behalf of the Shipping Board.

The Problem of the Hull and Its Screw Propeller

BY REAR ADMIRAL C. W. DYSON, U.S.N.

This paper, which will be published in complete form in a later issue of *MARINE ENGINEERING*, outlines the research and investigations on the relation of the hull to the screw propeller problem carried out by the author over a period of several years. In making the selection of data upon which to base formulas and design data, it is necessary to confine consideration to hulls of fine lines with propellers so placed that the chances of decrease in propulsive efficiency due to hull effect are reduced to a minimum. The propellers which are fitted to these hulls must all have practically the same radial distribution of the projected areas, must have the same general forms of blade sections, must be true to pitch, fine-edged and smooth in order to eliminate as many variables as possible from the design equations. Variations in hulls, resistance of hulls and appendages, the location of the propeller in relation to the hull are all given consideration and their effects on the design of a propeller are determined. The questions of small diameter propellers carried as deeply as possible in the cases of deep draft vessels, propellers for double enders, propellers for tunnel boats, etc., have not been touched.

DISCUSSION

This paper gives the most recent and authoritative statement of the method of powering ships and designing propellers, by one who is recognized as having unusually successful experience in this field. Commander William McEntee, U. S. N., while recognizing the great value of this method, based as it is on the performance of ships on trial, regretted that it had not been cast into a simpler and more logical form. W. W. Smith, chief engineer of the Federal Shipbuilding Company, having used the method successfully, reported that he found the method difficult to use and that further there was great difficulty in following a line of reasoning from cause to effect. It may be admitted that any method, however difficult, which gives satisfactory results is worth all it costs.

Annual Banquet

At the annual banquet of the Society, which was held at the Waldorf Astoria hotel on the evening of November 12, over 1,200 persons were present. Homer L. Ferguson, president of the Newport News Shipbuilding & Dry Dock Company, acting as toastmaster, introduced as the first speaker Congressman George H. Edmonds, of Philadelphia, a member of the House Committee on Merchant Marine and Fisheries, who discussed at length the provisions of the Jones Bill. The only other speaker was the Honorable John McCrate, a newly elected Supreme Court Justice of King's county, New York, who spoke on the "Limitations of the Law."

On Saturday morning the Society held an excursion, visiting the yards of the Federal Shipbuilding Company, Kearney, N. J., where the launching of a cargo vessel was witnessed.

Piston and Rings for Heavy Oil Engines

(Concluded from page 1003)

face which a tool always leaves on cast iron. The same treatment must be given the ring scores in the piston. The depth of these scores must be slightly greater than the thickness of the ring. The fit of the rings in the piston scores must not be too tight; in fact, it is better for the rings to be loose, for if the fit is tight the rings soon become almost a part of the piston, thus preventing any movement at right angles to the piston. Oil also burns in between the rings and the piston with the same result. One thing that has not been mentioned in making the ring is that it is necessary to just break the inner edges of the ring with a fine file when facing it. This prevents the edges striking into the corners of the ring scores should the work on the piston leave even a small fillet.

Many experiments have been made with steam engine piston rings and there is no trouble in making a steam piston tight. Professor Sweet's idea was to make a piston ring which was able to collapse, but could not expand beyond a fixed diameter. This he accomplished by making a joint in which a U-shaped piece was fitted on the inside of the ring at the joint. The key, as it might be called, fitted into two milled keyways in the ring. These two keyways were cut wider than the two projections on the key and a space was left between the abutting ends of the ring, which was cut at right angles to the ring. The key was fitted so that the outside of the ring was just the proper running fit in the cylinder. If the fit was not tight enough, the inside of the key ends were filed off and this allowed the ring to spring out to properly fit the cylinder. The idea of Professor Sweet was that if the ring could spring outwards without restraint it put considerable friction on the piston rings, which did no good, but lessened the power of the engine. The collapsing of the ring was only to provide some elasticity in caring for the expansion and contraction of the cylinder and piston.

While the design of the ring and its construction are important, more attention can be given to the composition of the metal in the rings for an oil engine. It is quite possible that some material other than cast iron can be found which will do better than any cast iron mixture.

When a hollow piston is used, the piston rod will hold the two sections together, in which case the reduced portion which would pass through a single piece piston has simply to be made longer, leaving a shoulder against which the lower half of the piston will rest. The nut on the upper end of the rod will then draw the parts of the piston tightly together, making a solid job. It is well to have the rod just above the shoulder made slightly larger in diameter than the rest of the rod, so that while a tight joint is thus obtained the lower half can be easily removed.

THE PISTON ROD

In describing the crosshead and piston (November *MARINE ENGINEERING*), the method of attaching the piston rod to the piston was fully described, so there is little to be said further on the subject.

The design which calls for the piston rod to be forged solid with the crosshead is one which is preferable to any other. If, however, the rod is made separately, it may be found advantageous to select a bar of the chosen grade of steel which is nearly the desired diameter of the rod and so requires only a light grinding cut to clean it up and bring it to the specified size. A rod so made wears better, as the surface of a bar is closer grained and harder than its interior.

The crosshead end of a rod made separate from the crosshead can have its thread larger than the diameter of the rod, thus insuring greater strength at this point. This cannot be done, however, on the piston end of the rod, and as a chain is no stronger than its weakest link, the enlargement of the crosshead end of the rod seems inadvisable.

Marine Engineering

Published Monthly by
ALDRICH PUBLISHING COMPANY
In conjunction with

SIMMONS-BOARDMAN PUBLISHING COMPANY
6 East 39th Street and Woolworth Building, New York, N. Y.

F. B. WEBSTER, Editor
H. H. BROWN, Managing Editor
S. M. PHILLIPS, Associate Editor L. S. BLODGETT, Associate Editor
A. H. BATTEY, News Editor

Contributing Editors

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WE GUARANTEE that of this issue 9,200 copies were printed; that of these 9,200 copies 7,624 were mailed to regular paid subscribers, 417 were provided for counter and news company sales, 414 were mailed to advertisers, 79 were mailed to employees and correspondents, and 666 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 117,650—an average of 9,804 copies a month.

MARINE ENGINEERING is a member of the Associated Business Papers, Inc. (A. B. P.), National Association of Periodical Publishers, Inc., New York Business Publishers Association and the Audit Bureau of Circulations (A. B. C.).

Standardization of Technical Education

A MATTER that came out incidentally in the discussion of a paper before the Society of Naval Architects and Marine Engineers is most interesting and important, and reaffirms an opinion recently given in these columns that technical education tends toward standardization. The president of the Webb Institute of Naval Architecture (formerly Webb Academy) reports that the only reason that the Institute has not already joined the company of degree-giving institutions is that they cannot now meet the requirements of the Board of Regents concerning instruction that is not related to the profession. Also it is reported that the Drexel Institute is on the way toward joining the great majority. Considering the fact that the Armour Institute did not at first grant degrees and that an attempt was soon made by the faculty of the Carnegie Institute of Technology to get into line, we may question whether any institution will be able to withstand the tendency toward standardization.

The Captain's Responsibility for His Ship's Stability

OF late years there has developed a tendency to require captains to know something of the stability of their ships. In some cases blue prints of curves of metacentric heights and other ship's properties have been furnished captains. In one case a captain inquired, "What am I to do with this?" "I don't know, but be sure to receipt for it."

Recent British books on naval architecture assert that many captains understand stability and suggest that a captain, being supplied with the heights of the metacenter, should be able to determine the metacentric height. Considering that the metacentric height desirable for a large ship is about one foot, while the height of the metacenter from the keel is likely to be 25 or 30 feet, is rather a rigid requirement. There is no question that some captains can learn to figure change of location of the center of gravity due to loading and stowage, and perhaps all ought to; but the exact determina-

tion of metacentric height is difficult for the naval architect, and an error of half a foot might occur in a captain's computation without much blame to him.

It is suggested that a more certain and a fairer way is to require the naval architect to determine the metacentric heights for all conditions of loading and stowage for the ship in ordinary service, and to give this information to the captain in the form of directions for loading, taking account of weight and bulk of cargo and locations of various kinds to keep within proper requirements. In case the captain has any question concerning stability it would be better for him to cable information and ask instructions.

The captain may always detect lack of stability from the effect on rolling. He should know the normal time of rolling and the limits of variation consistent with proper stability. Should the time of rolling increase unduly, and especially if the rolling becomes uncertain and shows a tendency to lag in recovery at the end of a roll, he should be instructed to return to port and cable for instructions.

When Is a Steam Pump Not a Steam Pump?

"WHEN is a steam pump not a steam pump?" No, this is not a silly conundrum and it does not belong in the funny column; this magazine may be funny, but not intentionally. For the answer is: "When it is a steam engine." A steam engine is run by an engineer, and an engineer must have a license; consequently no one without a license may start a steam pump when it is a steam engine. The regulations for engineers and their licenses are stiffening up, and properly so; but there must be some practical limit. A certain professor of mechanical engineering has found it convenient to get a license, and it is a question whether all the teaching staff in a steam laboratory should not be required to have licenses.

It is difficult to determine the line of demarcation between a steam pump and a steam engine. The first steam engines that worked on a vacuum and were called atmospheric engines were pumping engines. They were used to pump out coal mines because the transportation problems of those days were worse than they are now. They developed into the Cornish engine, which long held the title for fuel economy. Truly, they had a beam, but that was a matter of convenience; an off-shoot known as the Bull engine had the piston directly on the pump rod and had no beam. The valves of the Cornish engine were worked by a plug rod and it may be considered the progenitor of the direct acting steam pump.

But the direct acting compound condensing pumping engine, at one time the favorite for pumping stations of small towns, is unquestionably an engine and should have a licensed engineer, whether so required by law or not, provided any are yet in service.

Evidently a beam will not serve as a criterion, because only direct acting steam air pumps are now provided with beams; nor will a fly wheel, for a fly wheel steam pump is still a pump. Nor will size alone suffice, for an underwriter's fire pump will deliver a small brook. And yet it is undesirable that the night watchman should be required to go and wake up a licensed engineer to start a fire pump.

After all, engineers will agree that a steam pump is not a steam engine, and it should be lawful for an unlicensed oiler to start it.

Reception of Shop Visitors

IN the old easy good natured days anyone could go into a machine shop and have a look around; there might be a sign of "no admittance," but it was qualified by "except on business," and even if a foreman came to inquire over business it was easy to quiet his apprehensions. Such a free and easy system soon came to an end and visitors were properly required to go through the office and give some account of themselves; but it required a foreign war to put up a bar at the entrance with a watchman having police powers; a watchman who learned to look with suspicion on a stranger, particularly if well dressed and self-confident. The whole idea is relatively new and some establishments have not developed an etiquette to go with it; those establishments that have developed an inquiry office have a proper official who quickly and courteously finds out the business of all callers and either directs a person on his way or invites him to a cheerful waiting room. It is not necessary to dwell on the lack of system that requires a person to wait without the bar in the entrance hall, perchance furnished with a settee or two till his case can be passed on.

Council of the Naval Architects' Society

EVERY human undertaking has to be managed, and those responsible for the management must show discretion in the management, if things are to go on smoothly. The executive work of the management must be done by a small body; the real work is commonly done by one man on whose tact much depends. If the management is slack, there is confusion and waste of time; if the management is bureaucratic, those not within the circle are likely to be dissatisfied even though things go smoothly. In the affairs of the Society of Naval Architects the management is in the hands of the Council. It is obvious that a large body like the Society cannot conveniently handle any situation unless a working plan is provided in advance. If the plan is radically unsatisfactory to even a large minority, it usually cannot and certainly ought not to be carried through. If the plan is in general satisfactory, it can often be amended in the open meeting so as to suit the majority; but any large amendment is likely to be so difficult that it must be referred back to the management.

The important matter in preparing a plan is to determine so far as possible that it will be found acceptable to the meeting. The subject matter for consideration of the meeting is prepared for and discussed in the meeting of the Council in advance of the meeting of the Society. The Council is large and is representative, so that its opinion is likely to be satisfactory to the Society. The executive committee prepares the subject matter for the Council. Various ideas and propositions are presented either by members of the executive committee or by any member or members of the Society. In anticipation of the meeting of the Council all such business is sent in the form of circular letters to all members of the Council, who are asked to signify their assent, if they approve, or to propose amendments, if they see fit. In the light

of this correspondence the executive committee can usually forestall the opinion of the Council and prepare the business to meet their approval. Any proposition that the Council is unwilling to propose to the Society is properly laid aside. After full discussion in the Council, with such amendments as may be approved by them, the matter is put into form for presentation to the Society. The executive committee is purposely made up mainly of persons who can readily attend meetings so that action on any matter can be had without delay. The executive officer of the committee is the secretary whose tact and good sense are a dominant factor in the good management of the business of the Society.

Recess Shipping Board Appointments

TO say that the list of commissioners recently appointed to the Shipping Board by President Wilson is a disappointment is putting the case mildly. If any word of approval of the President's choice has appeared in the public press, it has escaped our notice. Among the shipping, shipbuilding and allied interests the sentiment is bitter against any further toying with the Shipping Board as a political football. Not only have the present appointments been delayed for five months, but with the exception of commissioners Benson and Donald, the men selected for this important service, however qualified they may be in their own particular spheres of activity, lack any technical knowledge of shipping affairs. Moreover, the political flavor of the appointments is too obvious to deceive the most liberal critic. If there is any national service which should be non-partisan and based upon merit alone, it is the control of the country's shipping affairs—particularly in foreign trade. Ample opportunity has been given to show the harm that can be done by entrusting the direction of the American merchant marine in the hands of men who lack a first hand knowledge of the intricate affairs of shipping. With possibly the two exceptions mentioned above, it is inconceivable that the new appointments to the Shipping Board will be ratified by the Republican Senate that is about to convene.

Electrically Propelled Merchant Vessels

TO a New York shipbuilder falls the distinction of making the first installation of electrical propelling machinery in a passenger ship. Elsewhere in this issue will be found a complete description of the vessel and her machinery. With a displacement of 3,580 tons on a 17-foot draft, the vessel attained a sea speed of 17.28 knots on her trials, the machinery developing approximately 3,000 horsepower. This installation is of special interest, not only because the *Cuba* is the first electrically propelled passenger ship in the world, but because the electrical propelling machinery is practically identical with that which is to be installed in the five new revenue cutters building on the west coast. The appearance of the first electrically driven passenger ship follows closely upon the entrance into deep sea service of the first electrically propelled American cargo steamer which was described in our last issue. Two duplicates of the cargo vessel are now being equipped with electrical propelling machinery and designs are being prepared on the Pacific coast for a large electrically driven passenger vessel.

 LETTERS TO THE EDITOR

**Information Wanted Regarding Service
Given by Condenser Tubes**

A joint investigation is being undertaken by the General Electric Company, Schenectady, N. Y., and the Diamond Power Specialty Company, Detroit, Mich., on the subject of the life of condenser tubes. The investigation is undertaken with the object of determining the possibilities of utilizing calorized copper tubes in this field.

Calorizing has, of course, proved its value in preventing oxidation of soot blower units, pyrometer protection tubes and other equipment at points of high temperature. What is not so generally known, however, is that calorizing has been utilized successfully for some time under certain conditions as a means of preventing corrosion.

Information is desired from engineers engaged in both stationary power plant and marine work respecting the service which they are getting from their condenser tubes. The co-operation of such engineers is requested and will be very greatly appreciated. In order to be of value, the reports sent in should contain as specific data as possible on the following points: (a) Metal of which tubes are made; (b) size and length of tubes; (c) life of tubes.

Communications on this subject should be addressed to the writer, care of the Diamond Power Specialty Company, Detroit, Mich.

Detroit, Mich.

ROBERT JUNE.

Cargo Motorships Versus Steamships

With considerable interest I have read the article "Cargo Motorships versus Steamships" by Professor Charles E. Lucke published in the September and October issues of MARINE ENGINEERING. In the October issue on page 837, under the heading "Maintenance," the author states: "Very little information is available for geared turbine steamers, but it seems fair to assume that the upkeep cost would be less than for reciprocating engines. In view of the fact that most of the expense is due to boilers, it seems that the fair proportionate figure would be \$8,000 for the geared turbine against \$10,000 for the reciprocating engine."

The marine geared turbine, including its necessary auxiliaries, represents a more refined type of machinery installation than the reciprocating engine. When the comparatively high speed at which turbines operate, the small clearance allowed and the importance of maintaining proper lubrication to the bearings and gears are considered, it will be seen that a better class of men are required for the operation of turbines than are necessary for the operation of reciprocating engines.

Sufficient engineers qualified for the operation of marine geared turbines are not obtainable today, whereas engineers for reciprocating engine operation are more plentiful. This scarcity of qualified turbine engineers is an important factor in the repair costs of turbines. In many cases the inexperience and lack of proper turbine repair equipment of ship repair yards have resulted in the practice of having the turbine and gear manufacturers perform the necessary major repairs at their plants, and the transportation involved, with its consequent delay, is costly. On the other hand, shops and experienced workmen for reciprocating engine repairs are in abundance and the shops are better equipped and situated for economical repairs.

In making a comparison of repair costs, it is well to take into account all the factors that exist, and those who have had turbine and reciprocating engine repairs performed recently realize how much more costly turbine repairs are.

While repair costs will no doubt vary with the type and manufacture of the turbine, it is believed that in general the cost of marine turbine repairs will exceed that of the reciprocating engine. It is also believed that the cost of repairs will in a large measure be proportionate to the degree of refinement of the machinery installation.

The difference in repair costs between turbines and reciprocating engines will not materially affect the final result in the comparison between motorships and steamships, but it would be interesting if Professor Lucke would state the basis upon which the assumption is made that the upkeep cost of the turbine steamship would be less than for reciprocating engines.

Hackensack Heights, N. J.

CARL E. PETERSEN.

Speed of Diesel Engines

I note with interest on page 934 of the November issue two editorials under different headings that are not connected in treatment but which, as a matter of fact, have a great bearing on each other. The paragraphs I refer to are "Loss of Efficiency with High Speed Propellers" and "Increasing the Power of Diesel Engines."

Having had a great deal to do with propeller designing and applications, and having made considerable study of the prime motive question relative to ships, I have deduced the general conclusion that the Diesel engine designers have striven for efficiency of their engine rather than for the total efficiency of the ship which they are to propel.

Diesel engines to compete with geared turbines or reciprocating engines in merchant ships with coarse block coefficients will have to be produced at shaft revolutions that are consistent with the type of hull they are to drive, and up to the present time the twin screw installation has seemed the most logical for either converting such merchant ships or for the installations in new designs because of the high speed at which engines are required to run and the inability of the propeller in a single unit installation, at the speed the engines are designed to run, to show any sort of propulsive efficiency.

In order to reduce the total cost of the Diesel installation, a single unit must be resorted to, as I see it, which will revolve the propeller at speeds within its scope, and until that time the operation charges of Diesel engine driven vessels cannot be made to indicate the true value of this type of prime mover.

The electric drive installations made by the General Electric Company for the steamers *Cuba* and *Eclipse* were held down to 100 revolutions, and while this is 15 revolutions higher than the average turbine installation, the efficiency loss does not become serious, but the tendency to hold the revolutions down indicates that the electric drive people have in mind the ultimate comparison with the reciprocating engine and have endeavored to provide for the shipowner the ultimate economy. The Diesel engine designers, as I see it, must follow suit or lose a portion of their decided advantages.

New York.

S. D. LEVINGS, Vice-President,
Columbian Bronze Corporation.

Steamboating on the Mississippi

Up and down the "brown Mississippi that rushes along from the snow to the sun" there used to float famous steamboats whose splendor was a marvel in the way of comfort and luxury for those bygone days, and even today the names of the *Robert E. Lee* and the *Natchez* are remembered by many as all that was palatial in travel. On the early steamers of the rivers were rooms for its passengers and they were given the names of the various states of the Union (the largest or main saloon was called the "Texas") and the name "state room" thus had its origin.

Mark Twain has made the river life known to us in a way which no other writer has even approached. The great race between the two boats named is talked of today by those whose hair is white but whose memory still serves. Fat pine was the fuel, and, if tradition is to be believed, when a race was on, fat pork was thrown into the furnaces of the boilers to help in keeping up steam, and, of course, a nigger was perched on the safety valve lever. Those days are gone, yet in many a Southern home and hostelry may be seen pictures of the famous river boats with the flames belching from the tops of their smoke stacks.

Of those who took part in these stirring events few are left from whom we can hear first hand accounts of just how the trips up and down to St. Louis were made, and only the other day one of the last of the great river men wrapped the draperies of his couch about him and laid him down to pleasant dreams. He was Captain Peter Peppers, first mate of the *Natchez* when she made her famous race against the *Robert E. Lee* to St. Louis and also when she made her record cotton carrying trip. During the Civil War Captain Peppers took to blockade running and did well at it. He mourned the decay of the river traffic, but was a firm believer that the great river would again come into its own. He knew the "coast," as they call the river along its border, as few ever knew it, and he was believed to be able to smell a snag or a sand bar in the darkest night. Those who knew him say that to talk to him of old river days was more interesting than seeing a good play, and now that he has "made his last landing" the river will be lonely indeed.

New Orleans, La.

W. D. FORBES.

NEW BOOKS

Applied Naval Architecture

REVIEWED BY C. H. PEABODY, DR. ENG.

APPLIED NAVAL ARCHITECTURE. By W. J. Lovett. Size, $5\frac{1}{2}$ by $8\frac{3}{4}$ inches. Pages, 654. Tables and diagrams, 361. New York, 1920: Longmans, Green & Company.

In the preface the author announces that this book is intended for the use of those engaged in the design and construction of moderate speed merchant vessels, and it undoubtedly presents the matter in the way he finds interesting from his own experience. It will be useful for a student to read, after he has completed a theoretical course of instruction, because it will give him a very different view of the subject from that found in the standard text book.

The first chapter is on bilging, discussing the bilging of a rectangular box with and without compartments and then gives in detail the computation for the bilging of an actual ship; here and throughout the book the author gives copious computations largely in tabular form. For some reason the tables are photographed from hand-written copy, and, though legible, are annoying to use. This method of attack allows the author to place the most recent work in naval architecture in front; he gives a very good résumé of the bulkhead committee and examples of determination of floodable length.

Next the author gives Board of Trade Regulations at great length, and then is ready to discuss design. Conforming to his restriction of his work to moderate speed, he announces that his speed length ratio is 0.5 or thereabouts. For such speed and type of vessels the usual method of design is apt to be that set forth by the author, namely, all the dimensions and proportions for the new ship are assumed and then the designer makes computations to see if they fit, and to find if there is any advantage from minor modifications. This chapter is followed by a discussion of freeboard; here again the author gives recent work of committees.

There has grown up a tendency to demand that the captain

shall know something about his ship; not how to navigate her, but what her scientific properties are. A chapter is here given on ships' curves—like curves of centers of buoyancy, metacentric curves, etc. Evidently the captain is supposed to have these curves and use them, and "any captain should be able to calculate for himself the approximate height of the center of gravity in any condition of loading." Fortunately, the matter of stability is brought down to one plain requirement that the metacentric height shall be one foot. The recommendation of one foot is sensible and simple, but it appears to be a little hard on the captain that he should be responsible for it.

There is a good discussion of launching, following the usual British method, including the effect of camber of the ways.

The discussion of power adopts Froude's circle notation in connection with the use of information from models. The author makes the common error of assuming that Tideman made experiments on surface friction; his work being monumental and in Dutch, few have found his statement that he did *not* make determinations of surface friction. The matter of wave interference is concisely stated. The discussions of shallow water resistance and of the trochoidal wave are very conservative.

Considerable space is given to steering and computations for the rudder and stock, attention being called to the fact that the most unfavorable conditions are likely to occur during backing.

Half way through the book the author takes up stability and trim, subjects which come near the beginning of the usual text book. Since his attention is given to the application rather than the theory of naval architecture, there is no complaint that his treatment is brief and conventional. Some space is given to grounding on hard bottom or in mud.

Following the usual English practice, the author opens his discussion of strength by a general survey of strength of materials, riveting and girders, including lattice girders. Why this is considered necessary is curious, as no one unfamiliar with mechanics should undertake to read the strength of ships. The computation for bulkheads appears to be confused, if not doubtful. A valuable feature is the statement of experiments by aid of Stromeier's strain indicator on the *Wolf* showing less stress than given by the usual calculation, although the vessel was purposely placed in trying conditions at sea, the conclusion being that conventional computations for longitudinal strength of ships are sufficient. Reference is also made to Bruhn's work on transverse strength. A subject not usually found in text books, namely, the strength of caissons for dry docks, receives a general treatment. In the chapters on strength are given tables of weights, moments of inertia, etc.

A useful chapter is included on tonnage by the methods of Great Britain and other nations, and also for the Suez and Panama Canals. The book closes with a table on weights, stowages and general tables, including logarithms.

Seaman's Handbook for Shore Leave

AN important little publication for American merchant seamen, whether in the engine room, deck force, or stewards' department, and quite as valuable to officers as to men below the licensed grades, is "The Seaman's Handbook for Shore Leave," a compilation of specific and original data regarding facilities for service to sailors in 325 of the ports of the world, which is soon to appear in a revised edition of 164 pages, in vest pocket size.

The book is published by the Social Service Bureau, United States Merchant Marine, under the direction of the Bureau's chief, Mrs. Henry Howard, whose headquarters are at the Boston Custom House.

Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding Will Be Answered in this Department

CONDUCTED BY JAMES L. BATES

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so.

Rivets in Stiffening Ring Spaced to Clear Studs

Q. (1108).—I would like to have you settle a dispute between A and B. A says that it is practical and proper to space and drive countersunk head rivets through bilge and doubling plate in way of sea chest to hold calking of both plates where "cut-out" comes for strainer.

A. (1108).—The best practice as exemplified by the detail plans of several large building yards working to United States Navy specifications supports A's contention. A heavy cast steel liner is worked round the opening or "cut-out" in the shell plating. This liner is about the width of the sea

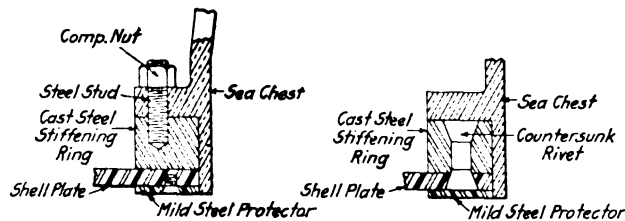


Fig. 1.—Section Through Stud

Fig. 2.—Section Through Rivet

chest flange and is riveted to the shell by countersunk head and point rivets. The sea chest flange is attached to the liner by steel studs so spaced as to clear the rivets through the liner. The studs are carefully fitted so as not to extend entirely through the liner (see Figs. 1 and 2).

Forces Acting on Keel Blocks While Docking Vessel

Q. (1107).—When a ship with considerable drag is being docked in a dry dock, say with draft 20 feet forward and 26 feet aft, the after end of the keel touches the blocks first, and after touching, as pumping down continues, the extreme after block on which the keel is resting tends to tip over aft, indicating that there is a force tending to move the ship aft until she lays all along on the keel blocks.

Please explain the cause of this, also give the magnitude of this force relatively to some element of which it is a component.

A. (1107).—When the vessel is entirely afloat just prior to her keel's touching the keel blocks, her center of gravity is in the same perpendicular line to the water surface as her center of buoyancy. This is essential to her condition of equilibrium. At any instant during pumping down, after her keel aft has touched but before it lies all along on the blocks, the vessel is supported by two forces—one the keel block acting at the after extremity of the keel, and the other the vessel's buoyancy. The point of application of this latter force has moved forward from its position when the vessel was afloat due to the decrease in draft aft. The buoyant force continues to act upward and the weight of the vessel to act downward at its original position both along lines perpendicular to the surface of the water.

Therefore we have three forces acting upon the vessel—the buoyant force forward, the force exerted by the keel block aft, and the weight just aft of the buoyant force. Now the buoyant force and the ship's weight are both acting along lines perpendicular to the surface of the water. Hence, the ship being in equilibrium, the supporting force exerted by

the after keel block must also act perpendicular to the water's surface and there can be no fore and aft component tending to tip the keel block aft.

The foregoing is a theoretical statement of the case and is believed to represent the actual condition very closely. External forces may, however, operate to produce extraordinary results. For instance, during pumping down every effort is made to keep the vessel stationary in both the transverse and fore-and-aft direction. This is done by means of lines and side shores. Even where these are handled with great care it is possible to introduce forces, not considered above, which might slightly affect or tend to affect the vessel's position. Thus an undue strain on lines leading aft might produce slight motion astern, resulting in the tipping tendency in the after keel block referred to. Ordinarily, however, such forces are negligible in amount and always they are indeterminate in both amount and direction.

Horsepower of Internal Combustion Engines

Q. (1109).—Please explain formula for horsepower of internal combustion engine $\frac{P \times A \times L \times \text{explosions}}{33,000}$ and give example worked out.

J. P. H.

A. (1109).—The formula to which you refer is usually written in the following form:

$$\text{Horsepower per cylinder} = \frac{P \times A \times L \times \frac{N}{q}}{33,000}$$

where

P = mean effective pressure in pounds per square inch during the power stroke.

A = net area of the piston face in square inches.

L = length of stroke in feet.

N = number of revolutions per minute.

q = number of revolutions per power stroke.

In the case of the ordinary 4-cycle engine, where alternate downward strokes are power strokes, $q = 2$ and the expression for horsepower becomes

$$\frac{P \times A \times L \times N}{2 \times 33,000}$$

In the case of the ordinary 2-cycle engine, where each down stroke is a power stroke, $q = 1$ and the expression for horsepower becomes

$$\frac{P \times A \times L \times N}{33,000}$$

The above represents the result of applying the principles, "work is the product of force by the distance through which it acts, and power is the rate of doing work or the quotient of the work divided by the time in which done."

The force is furnished by the explosion of the gases in the cylinder. Its amount is determined by the net area of piston face in square inches and the mean effective pressure of the explosive gases during the stroke = PA .

The distance moved is that traveled by the piston under the pressure of the explosive gases during one minute, which

is $L \frac{N}{q}$ ($\frac{N}{q}$ really is the number of explosions per minute.)

The number 33,000 expresses the number of units of work (in foot pounds) which the most powerful dray horse could perform in one minute. It was fixed by Watt at a time when the steam engine was taking the place of the horse in mining and other kinds of machinery. The expression of the power of an engine in terms of that of a number of horses accordingly conveyed a fairly definite meaning. The standard thus established has been accepted for both land and marine machinery ever since. The following example will serve to illustrate the application of the above formula:

Given a six-cylinder, four-cycle gas engine having a cylinder 10 inches by 11 inches operating with a mean effective pressure of 65 pounds per square inch at 460 revolutions per minute. Required the horsepower:

$$P = 65, A = 78.5, L = 11/12, N = 460.$$

$$\text{Horsepower} = \left[\frac{65 \times 78.5 \times 11/12 \times \frac{460}{2}}{33,000} \right] 6 = 196.$$

Pitch of Propeller

Q. (1115).—Explain how (the correct way) to find the pitch of a propeller. J. P. H.

A. (1115).—In "Practical Marine Engineering," seventh edition, pages 606, 607, 608 and 609, Admiral Dyson describes in detail the methods used and explains the principles involved in measuring the pitch of a propeller.

If you are particularly interested in small boat propellers, a method of pitch measurement especially suited to this type is described by A. E. Potter in a book published by the Rudder Publishing Company in 1905 and entitled "On Modern Screw Propellers."

Reversible Propeller

Q. (1116).—Please describe a reversible propeller and explain how it works. J. P. H.

A. (1116).—In cases where vessels are intended to utilize both or either sail and machinery for purposes of propulsion, it is desirable and, in fact, essential to eliminate the drag resulting from an idle screw when traveling under sail alone. This has been done by withdrawing the screw entirely from the water by fitting a screw having feathering blades capable of being turned so that the blades lie nearly in the stream lines, and by fitting a two-bladed screw in a carefully designed aperture in the dead wood so as to be entirely masked thereby at the will of the commanding officer.

In addition to its use upon vessels employing both sail and propelling machinery, the reversible screw is used on small motor-driven craft for backing without reversing the engine.

The original patent covering reversible screws was taken out in 1844. It contemplated two blades having shanks fitted into the boss. Short levers were secured to the shanks within the boss. These levers were linked to a sliding collar outside the boss. This collar was capable of fore and aft motion and was operated by bell crank levers from within the vessel.

At a somewhat later date designs were developed which obviated the necessity of fitting external bell cranks, collars, etc.

At the present time reversible screws involve the fitting of blades on shanks to large hollow bosses. These shanks are rotated either by internal bell cranks actuated by shafting working inside the main propeller shaft or by an internal shaft carrying worm threads or bevel gears.

The Bureau of Navigation, Department of Commerce, reports 119 sailing, steam, gas and unrigged vessels of 226,603 gross tons built in the United States and officially numbered during the month of October.

PERSONAL MENTION

F. L. CHAMPAGNE has resigned as superintendent of hull construction at the Sparrow's Point plant of the Bethlehem Shipbuilding Corporation. Mr. Champagne has been connected with the company since 1899.

JOHN L. COLLYER, superintendent of hull construction at the Sparrow's Point plant of the Bethlehem Shipbuilding Corporation, has offered two scholarships for the courses in industrial organization and hull construction at the Johns-Hopkins University, Baltimore, Md.

WALTER MURTAUGH has been appointed New York representative of the Bath Iron Works, Bath, Me. This company has just opened a New York office.

JAMES LEE ACKERSON, former vice-president of the Emergency Fleet Corporation, who was recently named second vice-president of the Merchant Shipbuilding Corporation, has



J. L. Ackerson

commenced duty at the Chester yard. He will also be one of the directing heads in the Philadelphia offices. Mr. Ackerson graduated from the United States Naval Academy with the class of 1901, and since that time has been more or less actively engaged in the assembling of ocean going vessels. He saw four years' service at sea, having held an appointment at the New York Navy Yard. He was also connected with the Naval Department of Design and Construction, and in addition

to this rounded out a term of service in the Navy Yard at Mare Island, California, where he was in charge of new ship construction. While still holding the rank of commander in the Construction Corps of the United States Navy, he was appointed vice-president of the Emergency Fleet Corporation, from which post he resigned early this year. He also resigned from the naval service in February.

GEORGE J. SANTA CRUZ, who has been appointed district director of the United States Shipping Board for the South Atlantic division, left recently for Savannah, Ga., where he will have supervision over all operations of the Shipping Board from Wilmington, N. C., to Tampa, Fla.

RALPH B. FERRIS has resigned as naval architect from the Atlantic, Gulf and Pacific Company, Midwood, Brooklyn.

C. H. MARSHALL, who has been manager of the operating department of the Shipping Board at New Orleans, has been made Shipping Board agent at Galveston, Tex.

FRANK J. REYNOLDS is at the New York office of the Standard Shipbuilding Corporation, replacing Captain C. C. McCarthy, who recently resigned to organize the American International Steamship Company.

CHARLES H. MILLER, assistant to J. A. Ubsdell, vice-president of the Great Lakes Engineering Works, has resigned on the reorganization of the company and has started the Wolverine Sales Company at Detroit. He was formerly secretary to Theodore E. Ferris.

C. S. HERMANN has resigned as chief chartering executive for the Shipping Board and has announced that he will conduct a general steamship brokerage company, with offices in the Whitehall building, 17 Battery Place, New York.

T. C. HAMMOND recently resigned from the Merchant Shipbuilding Corporation to accept a position as general manager of the Mutual Shipping Service Corporation, 35 South William street, New York.

CARL C. LORENTZEN has recently accepted the appointment as district superintendent for the United States Shipping Board in the district including all Baltic and Scandinavian ports. Mr. Lorentzen began his career as an apprentice in the blacksmith and marine engine shops of various Danish navy yards and after two years of this work entered the Danish Naval College for shipbuilding and marine engineering at Copenhagen, from which he graduated as an assistant naval engineer. The next eight years he served in the Danish Navy as a marine engineer, and in the Burmeister and Wain shops. Part of this period was spent in Scotland in connection with British shipbuilding, and in the United States inspecting American shipbuilding practice. While in Scotland he did post graduate work at Birmingham University. Since then he founded a marine engineering school in Copenhagen for training Danish marine engineers. In 1900, although a Danish citizen at that time, he was attached to the United States Commission in Paris in charge of the government engineering exhibit at the Paris Exposition. From 1903 to 1909 he was a member of the faculty of the school of applied science at New York University, during which period he originated and organized the American-Scandinavian educational movement. During the war he served as chief engineer on Shipping Board vessels sailing between New York, Baltic and Scandinavian ports. Since April 1, 1920, until his present appointment, he has been a representative of the Staten Island Shipbuilding Company, New York.



Carl C. Lorentzen

GEORGE A. BROWN, surveyor of the American Bureau of Shipping, recently sailed for Havre to represent there the Bureau for northern French ports.

HERMANN WINTER has been appointed manager at Hamburg for the American Line of the International Mercantile Marine Company, of New York. He will relieve J. J. McGlone, assistant to the president of the International Mercantile Marine Company, who has been in Hamburg since December, 1919, when the American Line re-established communication with Germany.

W. C. FOLEY has been appointed chief surveyor of the American Marine Insurance Syndicate. His experience includes twelve years with the Newport News Shipbuilding & Dry Dock Company, where he served as chief hull draftsman, as naval architect, and as assistant superintendent. He also has been four years abroad supervising the construction of submarines for the Austrian government. He then became associated with the Lake Submarine interests and later was made vice-president and general manager of the California Shipbuilding Company, of San Pedro, Cal.

CAPTAIN J. HOWARD PAYNE, former Seattle agent of the Shipping Board, has been made assistant director of the Seattle district agency of the sea service bureau of the Shipping Board.

JOHN A. DONALD, commissioner of the United States Shipping Board, has accepted the appointment for a new term in the same capacity with the Board.

L. C. WILSON, for the past two years general sales manager of the Chain Belt Company, Milwaukee, Wis., has been elected secretary of the Federal Malleable Company, West Allis, Wis. He will be succeeded as sales manager of the Chain Belt Company by Clifford F. Messinger.

JAMES W. RYAN, former special assistant to Attorney General Palmer and attorney for the United States Shipping Board, has been appointed assistant United States District Attorney for the southern district of New York, in which position Mr. Ryan will conduct the admiralty litigation of the Shipping Board, War, Navy and other governmental departments.

COLONEL EUGENE R. WEST has been appointed acting counsel for the United States Shipping Board Emergency Fleet Corporation for the northwest district, with headquarters at Seattle, in which capacity he will carry out the legal formalities connected with the closing of the government shipbuilding programme in this district.

LAWRENCE J. BRENGLE has been appointed as underwriter for the American Marine Insurance Syndicate B and C sections. Mr. Brengle has been connected with the marine insurance business for many years and was for some time adjuster for Johnson & Higgins. He has recently been with the North American Insurance Company in its New York office.

LORD WILLIAM JAMES PIRRIE, prominent in the British shipping industry, is at present head of a commission making an extended tour of the United States investigating the resources of fuel oil in this country. Lord Pirrie has been with Harland and Wolff, Belfast, since 1862. In 1878 he was taken into the firm as a partner, and has been chairman of the board of directors for many years. In March, 1918, he became controller general of merchant shipping of Great Britain and served in this capacity until after the armistice was signed.



Lord William James Pirrie

JOHN J. LAMB has been appointed safety engineer at the headquarters office of the National Safety Council, Chicago, succeeding R. H. Guerrant, who has taken up sales engineering work with the Industrial Appliance Company, of Chicago.

W. WOODWARD WILLIAMS, vice-president of the Reading Iron Company, Reading, Pa., has resigned from that concern to become assistant to the president of the Pittsburgh Gage & Supply Company, Pittsburgh, Pa.

A. B. WAY, until recently secretary and general manager of The Bridgeport Chain Company, has become affiliated with The Chain Products Company, of Cleveland, Ohio, in the capacity of district sales manager for New England, with headquarters at the company's New York office, 150-152 Chambers street.

Shipbuilding and General Marine News

Contracts for New Ships—Shipyard Improvements—
Engineering Projects—Improved Appliances—Personal Items

KERMIT ROOSEVELT HEADS OWN STEAMSHIP COMPANY

Concern With \$1,000,000 Capital Plans Operations "On a World-Wide Scale"

Among the recent prominent developments in the shipping field was the formation, under a Delaware charter, of the Roosevelt Steamship Company, capitalized at \$1,000,000, the incorporators being Capt. Kermit Roosevelt, Russell Goldman and Max Zaliels. The incorporation papers, filed at Dover, Del., gave little information regarding the new concern beyond its aim "to build, own and operate ships."

Russell Goldman is a director in the C. A. Colman Company, dealers in cotton goods at 74 Worth street, New York City. Mr. Zaliels is associated with Herman Goldman, with law offices at 120 Broadway.

"The Roosevelt Steamship Company plans to operate on a world-wide scale," it was said at Mr. Goldman's office. "It plans to acquire ships and to build if necessary."

The formation of the corporation marks the entrance of Captain Roosevelt into the maritime field "on his own." Up to the present, although some time in the shipping arena, he has appeared merely as an official of various companies.

Among these companies were the Ameri-

can Ship & Commerce Corporation, the holding company of the Cramp Shipbuilding Company, and the Kerr Navigation Company, which Mr. Roosevelt joined in September, 1919, as secretary. Last October he resigned, shortly after the W. A. Harriman interests had acquired the holdings of H. F. Kerr and A. E. Clegg in the Kerr Navigation Company, and the subsequent sequestration of Federal agents of \$4,000,000, the proceeds of the deal.

Captain Roosevelt, then vice-president of the Kerr Navigation Company, saw in the transfer of the Kerr stock to the Harriman interests a possibility that the Hamburg-American Line might turn the transaction to its benefit. In a published statement he bitterly criticised the seizure of the \$4,900,000 by Federal agents, who acted on the theory that taxes might not be paid on it, declaring that it was a coup engineered by the Harriman combination.

Maj.-Gen. George W. Goethals was president of the American Ship & Commerce Corporation at the time that Capt. Roosevelt was secretary.

NEW ENGINEERING FIRM

Wide Maritime Field Covered by
Organization of Experts

The Maritime Engineering & Sales Corporation, incorporated in September of this year, has established its principal offices at No. 2 Rector street, New York, and will conduct a steamship brokerage and marine engineering business, specializing as consulting engineers for and in the sales of auxiliary and deck machinery and equipment, cargo-handling gear, and Diesel and electric propulsion of ships. Branch offices or agencies will be established in the Great Lakes district, Atlantic coast ports and the Gulf district.

Arrangements have been made with the Allan Cunningham Company, Inc., that the new corporation will be sole Eastern distributors of the well-known Cunningham marine machinery and equipment, the Cunningham electric machinery especially having gained national recognition among shipbuilders and operators.

Mr. George H. Jett, who has been elected president and treasurer, brings to the firm a large engineering and marine experience. Previous to the war he was engaged in electrical and marine engineering fields on the Pacific Coast. During the war he served first as engineer officer on the *South Dakota*, and later as aide to Admiral H. P. Jones, and as repair officer at Newport News, in charge of repairs to vessels of the cruiser and transport force. For this service Mr. Jett received exceptional commendation and recognition from both the War and Navy Departments. Since resigning from the Navy, and until July of this year, Mr. Jett was connected with the Construction and Repair Department of the United States Shipping Board.

Mr. I. F. Halton, vice-president and secretary, has a wide acquaintance in marine circles. He was formerly president of the Bennet Flue Blower Company, the pioneer manufacturers of marine soot blowers.

Mr. E. H. Le Tourneau has recently joined the staff of the corporation as chief engineer. He is a graduate of the University of Minnesota, and is an electrical and mechanical engineer of broad experience, having been engaged for a number of years previous to the war as a designing and constructing engineer in the electrical, mechanical and marine fields on the Pacific Coast. During the war he served as officer in the Navy on active duty at sea, receiving unusual recognition from the Navy Department. More recently Mr. Le Tourneau has been connected with the United States Shipping Board.

MAY MEAN NEW CABINET DEPARTMENT

Shipping Board Developments
Likely to Bring Administrative Change

Investigation of Shipping Board operations by the Walsh Committee, according to the National Mercantile Marine Association, involves not so much the policies directed by the Merchant Marine Act, as the application of policies adopted by the Board under the law. The purpose of the committee apparently is to bring about administrative changes, rather than secure a revision of shipping legislation. A feature of the situation has been the desire of Admiral Benson, as chairman of the Board, to have the committee go thoroughly into all phases of activities, and to this end he has offered all documents and other information available to the Board.

Irrespective of the evidence which the committee is able to secure to support its charges, there is a feeling in some quarters in Washington that one of the results of the investigation will be a recommendation

for a Department of Marine, with a seat in the Cabinet. This opinion seems to be based upon the feeling that the party in power is responsible for the activities of the Board, and the head of the organization should be directly under the supervision of the President.

On the other hand, there are the opinions of Admiral Benson and others that the Board will ultimately assume the relation to shipping that the Interstate Commerce Commission bears to the railroads.

For Agreement on Rates

The recent drop in ocean freight rates, bringing the income of vessels close to the cost of operation, has led Admiral Benson to believe that the only solution of the situation is a world-wide agreement on shipping rates and regulations, tending towards uniformity of action and against rate wars. No steps have been taken by the Shipping Board to bring about this result, which is believed to be a matter for diplomatic action. Admiral Benson has stated that he would consider such a development favorably.

BOARD CONTRACTS ENDED

Six American Shipyards Finish Their Contracts

The Mobile Shipbuilding Company, the Western Pipe & Steel Company, near Los Angeles, Cal.; the Atlantic Corporation, Portsmouth, N. H., and the Pensacola Shipbuilding Company, which combined built 395,400 tons of vessels for the Shipping Board, delivered the last ships called for by their building programme during October. The Providence Engineering Corporation, in delivering the *Bayspring*, the tenth oceangoing tug for the Shipping Board, completed its work for the Government.

The Western Pipe & Steel Company built a total of eighteen ships, aggregating 156,400 deadweight tons. The last ship constructed was the *West Carmona*, an 8,800-ton cargo carrier, which was delivered on October 26.

The Pensacola Shipbuilding Company, at its Florida plant, completed its contract of ten 9,000-ton freighters with the delivery of the *Bayou Chico* on October 15. The company made arrangements to purchase four of its ships, but later the deal was called off.

The Atlantic Corporation sent the *Pagaset* out for her sea trials on October 27, and she was accepted by the Emergency Fleet Corporation's representatives. The *Pagaset* was the tenth ship constructed for the Government's account, and with her delivery the last contract was fulfilled.

The Mobile Shipbuilding Company produced a fleet of eight 5,000-ton steel cargo carriers for the Emergency Fleet Corporation. The *Atlanta of Texas* was the eighth ship to be delivered. Prior to the construction of the steel vessels the Mobile plant turned out six composite steamers of 3,500 deadweight tons each.

The last of the Government vessels building at the Chester (Pa.) yard of the Merchant Shipping Corporation was scheduled to be launched late in November, and the ways will be filled with private contract vessels for the following owners: Union Oil Company (Delaware), two single screw tankers, 10,000 deadweight tons each, triple expansion vertical inverted cylinder reciprocating engines; Tide Water Oil Company, two tankers of same type and tonnage as Union Oil Company; Shawmut Steamship Company, two single screw combination passenger and cargo boats, 10,500 deadweight tons each, Westinghouse cross compound turbines with double reduction gears; American Hawaiian Steamship Company, two twin screw freighters, 11,000 deadweight tons each, Diesel engines.

New Oriental Company Vessel

The steamship *Oritani*, the second fruit steamer built in Brooklyn, was launched at the yard of the Tebo Yacht Basin Company, foot of Twenty-third street, Brooklyn, November 6. The *Oritani* is the second vessel built by the Todd Shipyards Corporation for the Oriental Navigation

Company. Like her sister ship, the *Ormes*, she is of 1,200 deadweight tons, 227 feet over all, 33 feet 8 inches beam and 16 feet in depth. She is an oil burner equipped with the new Todd mechanical oil-burning system, with triple expansion engines of 1,400 indicated horsepower. The *Oritani* was sponsored by Mrs. Julian P. Gardner.

Submarine Boat Company's Ships Declared Seaworthy

Officials of the Submarine Boat Corporation, in a statement, have taken exceptions to testimony given before the committee investigating Shipping Board affairs by Thomas H. Purtell, who said he was an inspector of hulls in the corporation's yard in 1918, and described riveting work there as "fierce."

The statement claims that the vessels, the hulls of which Purtell testified he inspected, only recently have been examined by the department of the superintending engineer and found to be entirely tight and seaworthy.

The corporation officials say the ships in question have been through severe tests at sea, and are now reported by their masters and engineers to be in no need of repairs, which reports they claim should show Purtell's testimony to be unfounded.

Cleared of Monopoly Charges

Federal Judge Mayer has decided that Walter Moore and fifty-eight other defendants, including thirty-eight steamship lines, were not guilty of conspiracy to form a monopoly in restraint of trade, in violation of the provisions of the Sherman Anti-Trust Act.

The conspiracy alleged related to an agreement between the steamship lines and the members of the Steamship Freight Brokers' Association, whereby the steamship companies agreed to pay brokerage only to such brokers as were members of the Steamship Freight Brokers' Association.

A second account in the indictment charging restraint of interstate and foreign commerce has also been quashed by the court, after hearing arguments of counsel on the demurrer to the indictment.

Suits By Morse Companies

Suits for sums aggregating \$2,378,256 have been filed in the Supreme Court against the United States Shipping Board and the Emergency Fleet Corporation, by four steamship companies controlled by the United States Steamship Company, 50 Broad street, New York, of which Charles W. Morse is president, for damages caused by an alleged breach of contract on the part of the defendants. Each of the companies owns a vessel bearing the first part of the corporation's name, and the United States Steamship Company owns the Virginia Shipbuilding Corporation, which also figures in the suit. The suits are brought by the Binghamton, Huron, St. Paul and Minneapolis steamship companies.

THIRD MARINE SHOW

National Marine League Plans Big Display in January

The National Marine League is in the midst of lively preparations for a marine show in New York in January, 1921. The outstanding feature in the first New York show was the arousing of interest in the general public—the bringing of a great mass of American voters to a state of ship-mindedness. The interest which was so evident on all sides was instrumental in developing the second project—a marine show in Chicago, 1,000 miles from tide-water.

P. H. W. Ross, president of the National Marine League, who presided at the Chicago Show, was responsible for much of the success of the undertaking. His energy and enthusiasm proved definitely that the National Marine League exists to serve both the inland and oceanic necessities of the United States.

The Chicago Exposition had a great significance in that it represented the Marine East fomenting the great mass of people in the Inland West. It was as the turning of a key, the throwing open of the door to the seven great inland States—Illinois, Indiana, Iowa, Ohio, Missouri, Michigan, Wisconsin. These States comprise the most wonderful producing district in the world.

Being set, as it were, almost as a forerunner of the ushering in of an administration pledged to the support of the American Merchant Marine—the third National Marine Exposition will mark the turning of the tide in things maritime. It will herald a new era—the placing of the American merchant marine in a position of stability, which will further its uphill fight for supremacy on the seas.

Wood Hulls Good Tankers

Satisfactory results have been returned by oil tankers converted from the hulls of the Ferris type steamers built during the war, according to a report received recently from the National Oil Transport Company. The operation of these wooden vessels as tankers is declared to be the first time that craft of wood construction have been used to carry fuel oil.

At present the company is operating a fleet of three of these vessels in the oil trade between Tampico and Galveston. Two other vessels of the same type are rapidly nearing completion for this service.

In addition to the operation of the oil tankers the National Oil Transport Company has signed charters for the operation of five cargo steamers in the Pacific Coast trade. The vessels are at present nearing completion in Seattle shipyards.

Steam Navigation Board to Meet

Capt. N. L. Cullin, secretary-treasurer of the National Board of Steam Navigation, has sent out notices announcing that the forty-ninth annual meetings of the Board will be held at the New Willard Hotel, Washington, D. C., December 7 and 8, at 10:30 A. M.

\$36,500,000 CAPITAL IN SHIPPING COMPANIES FORMED IN OCTOBER

Only Ten Incorporations; Increase of One Over Previous Month, but Big Gain In Capitalization From a Year Ago

New shipping enterprises formed in October, with an authorized capital of \$50,000 or more, numbered ten, their combined authorized capital being \$36,500,000. This record shows an increase as compared with the organization in September of nine companies, involving only \$6,720,000, and as compared with an indicated investment of \$23,105,000 in October a year ago. The total is the largest reported for any month since June, according to the compilation specially maintained by the *Journal of Commerce*.

The indicated investment during the first ten months of the year appears as \$562,423,000, a figure more than two-thirds greater than that in any year since the outbreak of the war in 1914. Returns for the entire twelve months of 1919 showed an aggregate of only \$323,613,000, the previous top mark for the compilation. During January-October a year ago the combined authorized capital of the companies formed was almost exactly \$300,000,000 below the showing for 1920 to date.

The indicated investment in new shipping enterprise during the periods named is shown in the following table:

August-December, 1914.....	\$1,844,000
Year 1915.....	37,062,000
Year 1916.....	69,466,000
Year 1917.....	271,503,000
Year 1918.....	120,353,000
Year 1919—	
January.....	7,525,000
February.....	6,400,000
March.....	9,276,000
April.....	2,400,000
May.....	17,200,000
June.....	55,550,000
July.....	42,485,000
August.....	55,950,000
September.....	40,870,000
October.....	23,105,000
November.....	52,700,000
December.....	10,362,500
Total.....	\$323,613,500

Year 1920—	
January.....	\$76,305,000
February.....	33,380,000
March.....	61,850,000
April.....	178,835,000
May.....	31,083,000
June.....	86,050,000
July.....	26,250,000
August.....	24,550,000
September.....	6,720,000
October.....	36,500,000
Total ten months, 1920.....	\$562,423,000

Five companies were organized during the month, with an authorized capital of \$1,000,000 or greater, as follows: American Transatlantic Lloyd, Inc., \$7,000,000; American Transportation & Trading Corporation, \$20,000,000; American Siberian Corporation, \$4,000,000; Brazadeno Company, \$1,000,000, and Emerald Motor Ship Company, \$3,000,000. Only three companies of such proportions were organized in the preceding month, seven were started in August, four in July, fifteen in June, fifteen in May, thirteen in April, twelve in March, seven in February and ten in January. During the first ten months of the current year, therefore, there were 87 shipping concerns chartered, with an authorized capital of \$1,000,000 or greater.

The following list comprises the names. States of incorporation and authorized capital of shipping companies organized last month:

American Transatlantic Lloyd, Inc. Del.....	100,000
American Shipping Agency, Del.....	100,000
American Transportation & Trading Corporation, Del.....	20,000,000
Etna Steamship Corporation, N. Y.....	100,000
American Siberian Corporation, Del.....	4,000,000
Brazadeno Company, Del.....	1,000,000
Black Star Steamship Company, N. J.....	500,000
Dominican Steamship Company, Del.....	300,000
Emerald Motor Ship Company, Del.....	3,000,000
Mt. Washington Steamship Co., Del.....	500,000
Total.....	\$36,500,000

Old Cruisers Not Wanted

The old cruisers *Cincinnati* and *Raleigh* and the steamer *Supply* were ignored when bids were opened by the Shipping Board for a number of vessels, the highest offer being \$42,000 for the gunboat *Castine*, made by the Inter-Colonial Steamship & Trading Company of New York. Only eight of the 30 vessels offered brought bids of any sort.

The *Castine* and *Petrel* brought an offer of \$56,000 from R. Bruce Sommerville, of Pensacola, and for the *Petrel* alone Snare & Triest, of Washington, offered \$25,000, while there was a bid of \$35,000 for the gunboat *Machias* from Edward S. Hough, of San Francisco.

Bids for the steamships *Admiral H. Ailcen*, *Cigarette* and *Naushon*, and the tug *James H. Clark*, ranged from \$6,051 to \$8,250, and, as in the case of the gunboats, were well above the minimum sale price set by the Government.

"Ker" Ships Names Changed

The American Ship & Commerce Navigation Corporation announces that it has adopted for the nomenclature of its present fleet and any future vessels it may own, names with the prefix "Mount." This affects the vessels of the Kerr Company's fleet, the names of which began with "Ker."

The eleven vessels at present owned by the company will have the following names: *Mount Clay*, *Mount Bliss*, *Mount Brace*, *Mount Bowdoin*, *Mount Seward*, *Mount Sheridan*, *Mount Sherman*, *Mount Sherrill*, *Mount Sidney*, *Mount Sterling* and *Mount Summit*.

The only name specifically applied to any vessel of the fleet at present affects the steamship *De Kalb*, which is undergoing reconditioning and fitting for third class passenger trade. The *De Kalb* is to be renamed the *Mount Clay*. New names for other vessels will be announced later.

MORSE CONCERNS FAIL

George W. Sterling Receiver for Eight Companies

The Atlantic-Adriatic Corporation, of which B. W. Morse, son of Charles W. Morse, is president, and seven subsidiary companies, representing seven steamships, passed into the hands of a receiver November 17, in an equity suit instituted by Marsh & McLennan, insurance brokers, whose claim amounts to \$27,325.56 for advances made for insurance. The difficulties of the companies are laid to the lack of freight and the cut in transatlantic rates from about \$19 a ton, required to meet the costs of operation, to about \$16.

The indebtedness of the Atlantic-Adriatic Steamship Corporation is stated as being in excess of \$1,500,000. Additional claims are estimated at more than \$1,000,000. The total liabilities of the corporation are said to be more than \$3,000,000, and it is alleged that the defendant companies have not sufficient funds to meet their indebtedness.

The petition does not give any figures explaining the corporation's assets, but mentions in this connection ships, cargoes, bills of lading, etc. A. G. Lampke, of Lampke & Stein, counsel for the corporation, said the litigation is of a friendly character, and that Federal Judge Mayer had appointed as receiver George W. Sterling, assistant director of operations of the United States Shipping Board.

NEW SHIPPING BOARD LIST

Rear Admiral Benson Remains as Chairman

Reappointment of Rear Admiral William S. Benson as chairman of the Shipping Board was announced November 13 at the White House. At the same time announcement was made of the appointment of six other members of the new Board authorized by the Merchant Marine Act. The other appointments are:

Frederick I. Thompson, Alabama, Democrat, term of five years; Joseph N. Teal, Oregon, Democrat, four years; John A. Donald, New York, Democrat, three years; Chester H. Rowell, California, Republican, two years; Guy D. Goff, Wisconsin, Republican, one year, and Charles Sutter, Missouri, Republican, one year.

Admiral Benson is appointed from Georgia as a Democrat, and his term is for six years. The appointments are recess ones, and the nominations under the law are subject to approval by the Senate.

To Discuss Motor Boats

The annual motor boat meeting of the Society of Automotive Engineers will be held at the Automobile Club of America, New York City, Tuesday evening, December 14, during the week of the National Motor Boat Show. The technical session will be preceded by an informal dinner, at which C. A. Criqui will be toastmaster, and the speakers will be prominent members of the motor boat industry.

BUSINESS NOTES

Albert H. Hopkins has resigned from the presidency of the Engineering Advertisers' Association of Chicago, and from the management of the advertising and sales promotion departments of the C. F. Pease Company, Chicago, to become manager of the J. Roland Kay Company, international advertising agents, at their new building, 161 East Erie street, just east of North Michigan Boulevard, Chicago.

Mr. E. P. Williams, formerly with the McJunkin Advertising Agency, and later director of field work, Bureau of Market Analysis, Inc., has joined the staff of the Independent Pneumatic Tool Company, manufacturers of Thor air and electric tools. He will be located in the general offices, No. 600 West Jackson Boulevard, Chicago, and will have charge of the direct by mail advertising and sales promotion department.

Fairbanks, Morse & Company have purchased the entire business, consisting of all stock on hand, good will and liabilities of the Luster Machine Shop & Railway Equipment Company, 917 Arch street, Philadelphia, Pa. Fairbanks-Morse have opened a new branch at this address, under the management of Mr. D. W. Dunn, and will sell their complete line of engines, motors, pumps, etc. The entire personnel of the Luster Machinery Company has been retained. E. J. Luster, former president, will be manager of the machine tool division of the Fairbanks-Morse Philadelphia branch.

The International Western Electric Company has opened a new branch at 91 Rua Dos Ourives, Rio de Janeiro, Brazil. Mr. A. W. Burren, who will manage it, has spent the last two years traveling through Brazil familiarizing himself with the electrical requirements of his new territory. He has been associated with Western Electric interests for several years, and has been connected with its offices at New York, Antwerp, London, Buenos Aires and in Spain. Mr. Burren will be assisted at Rio de Janeiro by Mr. A. S. Santos, a sales engineer.

Mr. A. H. Ackerman, 427 Reaper Block, Chicago, has been appointed district sales representative of the Tacony Steel Company, Philadelphia, succeeding F. B. Hillwick. The Tacony offices have been removed from Marquette building to 427 Reaper block, Chicago.

The shipping, engineering and machinery exhibition, which was held at Olympia in the autumn of last year, was so successful that it has been decided to hold another upon similar lines at the same place September 7 to September 28, 1921. Plans and particulars can be obtained from Mr. F. W. Bridges, 36-38 Whitefriars street, London, E. C. 4.

J. J. Arnsfield, advertising manager of Fairbanks, Morse & Company, has been elected president of the Engineering Advertisers' Association of Chicago, vice A. H. Hopkins, who resigned his connection with the C. F. Pease Company to take charge of the domestic advertising division

of the J. Roland Kay Company. Mr. Keith J. Evans, advertising manager of Jos. T. Ryerson & Son, was elected vice-president, and Julius Holl, advertising manager of Link-Belt Company, was elected a director to fill the vacancy made by Mr. Hopkins' retirement.

Charles H. Israel has been appointed Eastern representative of the Kingsford Foundry and Machine Works, Oswego, N. Y., for the sale of Kingsford stationary and marine unafow engines. His New York office will be Room 1104 Equitable building, 120 Broadway, 'phone Rector 1845. The Philadelphia office is Room 722 Drexel building.

Mr. L. R. Fedler has been appointed district manager for the Keller Pneumatic Tool Company in the Milwaukee district, with offices at No. 915 Majestic building, Milwaukee. For the past twelve years Mr. Fedler has been associated with the sales organization of the Chicago Pneumatic Tool Company in the Milwaukee territory.

The Chicago Pneumatic Tool Company announces the removal of its rock drill plant from 864 East Seventy-second street, Cleveland, Ohio, to the Boyer pneumatic hammer plant at 1301 Second Boulevard, Detroit, Mich. The location of the company's Little Giant air drill plant at 1241 East Forty-ninth street, Cleveland, remains unchanged.

TRADE PUBLICATIONS

Marine Glue.—For all purposes where a waterproof glue is required, L. W. Ferdinand & Company, Boston, Mass., supply a special form of Jeffery marine glue. Instructions for the use of this glue are given in a pamphlet recently issued by this company.

Waterbury Rope.—A general catalogue, incorporating all the information about wire rope and cordage that the average user of rope would require, has been compiled by the Waterbury Company, New York City. This catalogue is arranged to quickly give the buyer the list prices and other essential data in connection with wire rope and fittings, armored wire rope, fibre-clad, and cordage.

Marine Hardware.—A catalogue covering the line of hardware produced by W. & J. Tiebout, New York City, is now being sent out. This catalogue gives special attention to marine, refrigerator and cabinet hardware, with specifications and prices for all material.

Marine Geared Turbines.—The General Electric Company, Schenectady, N. Y., has sent out a catalogue describing the design and installation of geared turbine units developed for merchant vessels. No previous data in this form has been issued by the General Electric Company, so that the work will prove of great value to those interested in a study of turbines or who contemplate equipping vessels with this type of machinery. The general principles of design and construction of the Curtis type impulse turbine, as well as the double reduction gears built by the company are both given a general treatment in this book.

Froude Dynamometers.—Bulletin F-70 of the C. H. Wheeler Manufacturing Company, Philadelphia, Pa., has been issued, describing the Froude type dynamometers for testing rotary prime movers of all types. Many illustrations showing dynamometers coupled to various types of engines are given in an attempt to show the various purposes to which Froude dynamometers are applicable. In addition to the general description, specifications for the dynamometers are also given.

NEW INCORPORATIONS

Ricameron Navigation Corp., Manhattan.—Capital, \$56,000; E. M. McBrearty, R. L. and E. L. Cameron, Bayside.

Haber Lighterage Co., Manhattan.—Capital \$40,000; F. J. McGeeney, A. J. and W. Haber, 11 Fourth Place, Brooklyn.

Erie Barge Freight Terminal Co., Buffalo.—Capital, \$100,000; S. J. Dark, W. O. Maltby, W. G. Gomez, Buffalo. (Erie Barge Terminal Co., dissolved.)

Baltic Shipping Co., Manhattan.—Capital, \$50,000; M. P. Breen, Jr., R. Mazzola, W. L. Carns, 128 Broadway.

Lamb & Ewart, steamship agencies, etc.—Capital, \$55,000; F. R. Hansell, J. K. Vernon Pimm, E. M. Macfarland, Philadelphia.

Stern Shipping Corp., Manhattan, insurance and forwarding. \$50,000; G. Henry, E. T. Stroud, S. Stern, 2 Stone St.

H. J. Wheeler Salvage Co., Brooklyn, vessels. \$25,000; C. and H. C. Berlin, S. Gondelman, 858 Flushing Ave., Brooklyn.

Great Gulf Steamship Corp., \$1,000,000; A. W. Britton, S. B. Howard, Robert K. Thistle, New York.

Globe Ship Repair & Marine Supply Company of New York, \$200,000; Cornelius A. Cole, Hackensack, N. J.; Robert A. Van Voorhis, Jersey City, N. J.; William E. Schiels, Jr., Brooklyn.

Diamond Steamship Laundry, Brooklyn, 5,000; J. E. and R. E. Stothard, N. Kaplan, 471 Eighth street, Brooklyn.

Oceanic Marine Supply Company, Manhattan, merchandise. \$100,000; W. J. Baker, F. L. Savage, H. B. Walker, 320 West Eighty-sixth street.

Marine Protective Corporation, Manhattan, to protect property, 1,000 shares common stock, no par value; active capital, \$5,000; W. F. Fennelly, F. X. Hennessey, W. Ingraham, 25 Broad street.

Overseas Forwarding Company, Manhattan, \$20,000; J. R. Walker, S. H. Cone, E. J. Smith, 118 West Thirty-ninth street.

Delaware & Atlantic Transportation Company, passengers; \$500,000; James R. Cisco, Trenton, N. J.; John D. Hawkins, Arthur J. Kingsbury, Dover, Del.

Bowne-Mortons Stores, Brooklyn, wharfage and warehousing. \$70,000; H. B. Gayley, H. J. Mayer, H. M. Samson, 149 Broadway.

Hebrew Transportation Corp., Brooklyn, steamship and railroad tickets; \$25,000; C. E. Benoit, H. J. Greenstein, H. Johnson, 320 Broadway.

Richmond Terminal Warehouses, Richmond borough, \$50,000; P. Meltzer, B. G. and L. P. Vigner, Tompkinsville.

Seven Seas Forwarding Co., Manhattan, \$5,000; P. A. Pabistel, J. Mikifer, O. Tiedeberg, 188 Wadsworth Ave.

Ellsworth Express Company, Inc., Brooklyn, N. Y., \$10,000; trucking, contracting, stevedoring; Edward N. Ellsworth, 387 Classon Ave.; Leslie H. Ellsworth, 95 Ryerson St.; Mortimer H. Michaels, 398 McDonough St., Brooklyn.

Roosevelt Steamship Co., build, own, operate boats, \$1,000,000; Kermit Roosevelt, Oyster Bay, N. Y.; Russell Goldman, Max Zaliels, New York.

Pearce Transportation Corp., \$100,000; C. T. Cohee, C. B. Outten, S. L. Mackey, Wilmington.

General Welding and Engineering Corp., \$100,000; Wray C. Arnold, Frank W. Fry, Frank A. Cabeen, Jr., Philadelphia.

Port Construction Co., Richmond Borough, \$6,000; W. O. Coburn, M. Rosenholz, S. H. Schener, 9 University Place.

Mexican Dock Corp., Manhattan, real estate and mortgages. \$500,000; F. and A. K. Kalb, J. G. Fenster, 206 Broadway.

Mitchell Ship Salvage Corp., raising sunken ships, etc.; \$4,000,000; T. L. Croteau, M. A. Bruce, S. E. Dill, Wilmington.

Daly Towing Line, \$15,000; M. M. Lucey, V. P. Lacey, L. S. Dorsey, Wilmington, Del.

Anchor Coal and Transit Line, boats, \$50,000; F. H. Locks, George P. Bauersmith, J. H. Scott, Pittsburgh.

Great Gulf Steamship Corp., Manhattan, \$1,000,000; A. W. Britton, S. B. Howard, Robert K. Thistle.

G. M. Luix Steamship Co., agents, \$100,000; Antonio B. Camara, Oscar M. Mallecler, James J. Suludes, New York.

McCormack Stevedoring Co., Manhattan, \$10,000; R. W. Burkner, H. Hampel, T. F. Fay, 438 Third street, Brooklyn.

Archibald McNeil & Sons Co., of New York, Manhattan, coal, \$2,000,000; M. J. H. E. Borchers, G. A. McLaughlin, 680 West End avenue.

Seacraft Corp. of California, Los Angeles, \$250,000; E. A. Featherstone, Dustin Farnum, H. E. Roach, R. R. Thomas, Harry C. Keefe, J. A. Talbot and Maroo H. Hellman.

Marine Construction News of the Month

Ship Contracts—New Ship Concerns and Shipyard Improvements—Terminal Projects—Government Contracts

SHIPS AND SHIPBUILDING

Pacific Coast Steamer, Vancouver, B. C.—The keel for a large coastwise steamer to take the place of the Princess Sophia will be laid soon at the Wallace shipyards.

To Start Steamer, Bath, Me.—Preparations for laying the keel of the sister ship of the steamship A. L. Kent on the ways vacated at the Bath Iron Works by her recent launching are being made.

Would Buy Wooden Vessels.—The purchase of some of the wooden ships controlled by the Shipping Board, and which have been vainly offered for sale, is sought by citizens of a South American nation.

Tankers, Wilmington, Del.—The Bethlehem Shipbuilding Corporation, Ltd., has received a contract from the St. Clair Navigation Company for four tankers, two of 10,600 tons and two of 6,900 tons, to be built at their Harlan plant.

Buys Vessels from Navy, Tampa, Fla.—The Denton-Shore Lumber Company has purchased five additional vessels from the Navy Department, including a destroyer, a yacht, a minesweeper and two barges, at a cost of \$200,000.

Recondition Steamer, New York.—The Amerika, former Hamburg-American Line steamer, has been turned over to the United States Mail Steamship Company by the Shipping Board, and plans are being prepared for her reconditioning.

To Build Small Vessels, Bagdad, Fla.—The Santa Rosa plant is likely to be reopened soon for the construction of small vessels. C. G. Mayo, of the Santa Rosa Sawmill Company, has been negotiating for the construction of seagoing barges.

Reconditioning Motorship, San Francisco, Cal.—A contract for reconditioning the motorship Annie Johnson, owned by the Matson Navigation Company, has been awarded to the United Engineering Company. The vessel will undergo extensive engine repairs.

Buys Schooners, Seattle, Wash.—Henry S. Seaborn, shipowner, has purchased three ocean sailing schooners, the Gamble, the Spokane and the Sophie Christenson, from the Fife Shipping Company, San Francisco, Cal. Mr. Seaborn's fleet now numbers six vessels.

Concrete River Steamers, New Bern, N. C.—Foundations have been laid for two concrete river steamers to be constructed by the Newport Shipbuilding Corporation. The work of forming and sheathing the vessels is well under way. Kirby Smith is superintendent.

New Munson Liner, Camden, N. J.—The keel for the new 6,000-ton passenger steamer which the New York Shipbuilding Corporation contracted to build for the Munson Steamship Line has been laid, and it is believed that she will be ready for operation late next spring.

To Rebuild Steamer, New York.—At an estimated cost of \$1,600,000 the Mallory Line has decided to have the steamer San Jacinto rebuilt and converted into a first-class passenger ship for the coastwise trade, from plans being prepared by Theodore E. Ferris, 30 Church street.

Would Buy Wooden Motorships, Seattle, Wash.—One of the big marine corporations of the Pacific Coast, whose identity has not been disclosed, is negotiating for the purchase of the wooden motorships Donna Lane and Muriel, the last two cargo carriers built in Seattle this year.

Keel Laid for Cargo Ship, Tacoma, Wash.—The keel for the first private cargo ship to be built in Tacoma shipyards has been laid by the Todd Dry Dock & Construction Company. The vessel, which is to be a 6,500-ton, all-steel motorship, is being built for the Alaska Steamship Company.

Repairing Vessels, San Pedro, Cal.—The Los Angeles Shipbuilding and Dry Dock Company has been awarded the contract for repairs to the steamer West Eldara, damaged on a reef outside of Honolulu. One hundred and forty-nine plates must be replaced on the vessel. Repairs amount to \$219,890.

To Complete Six Steamers, Mobile, Ala.—The launching of the 10,000-ton steamer Tuscaloosa City at the Chickasaw Shipbuilding and Car Company's yards a few days ago leaves six ships under construction at the yards, all of which are expected to be ready for commission during the coming year.

Passenger Liners, New York.—Theodore A. Ferris, 30 Church street, expects to complete the plans for two new passenger liners to be built for the Red D Line soon. These ships, which are to be about 400 feet long, are designed especially for service from New York to the north coast of South America.

Charleston Marine Activities.—The Western Wave, a Shipping Board steamer, is at the plant of the Charleston, S. C., Dry Dock & Machine Company undergoing general repairs. A new dredge, being built for work on Government projects at Savannah, is being pushed to completion by the company as fast as practicable.

Eight Motorships Bought, San Francisco, Cal.—The purchase of eight motorships by the Pacific Freight Corporation from the Australian Commonwealth is announced by W. L. Comyn & Company, general agents for the corporation. This gives the corporation the largest fleet of motorships flying the American flag on the Pacific.

To Have Electric Propulsion, San Francisco, Cal.—Steamers Archer and Invincible, which were built at the Union Iron Works and were originally equipped with geared turbine drive, are to be equipped with electrical propelling machinery at the Vulcan Iron Works, Jersey City. The General Electric Company supplying the machinery.

Steel Lighter, Fairfield, Md.—The first vessel built by the Globe Shipbuilding and Dry Dock Company has just been launched. It was built for the Ellicott Machine Company, is 150 feet long, 37 feet beam, 11 feet 6 inches deep, and is intended for harbor use. The next launching will be one of two 8,700-ton tankers for the American Fuel Company.

Capacity Production, Camden, N. J.—The New York Shipbuilding Company has as many orders on hand as it can handle for many months, and requiring the employment of 18,650 men. Seven passenger vessels will be built for the Shipping Board, four tankers for the Vacuum Oil Company and fifteen passenger and cargo vessels for various other interests.

Combination Tanker, Port Richmond, S. I., N. Y.—A combination molasses and oil tanker that the Staten Island Shipbuilding Company is building for the American Sugar Refining Company is scheduled for delivery next January. The contract was let last January, and the keel was laid five months after. The total cost will be a little less than \$1,500,000.

Three-Masted Schooner, Machias, Me.—The three-masted schooner Netherton, measuring about 300 tons net, launched at the yard of the Job Shipbuilding Company has been sold to parties at St. Johns, N. F., and will be ready for sea in a few weeks. A duplicate vessel will be rushed to completion and launched in about six weeks from the same yard.

Cargo Steamers, Glasgow, Scotland.—The International Mercantile Marine Company, New York, has been advised of the launching of the Leyland Line cargo steamer Hakarian at the yards of David & William Henderson & Company, Ltd., Glasgow. This vessel is the first of six 7,300-ton sister ships under construction by the Hendersons.

Converting to Oil Tankers, Baltimore, Md.—The new steel freighter Vaba, built by the American International Shipbuilding Company at Hog Island, Pa., has arrived at Baltimore, Md., to be converted into bulk oil carrier for the Charbonneau-Rajola Company, of New York. The Vaba makes five Hog Island built freighters now at Baltimore to be converted into tankers.

Recondition Steamer, Quincy, Mass.—The ex-German steamer George Washington, which has been turned over to the United States Mail Steamship Company, has been sent to the Bethlehem Corporation's Fore River yard for repairs estimated to cost about \$2,000,000; she is a steel, twin-screw ship of 25,570 gross tons, and was formerly owned by the North German Lloyd.

To Build for Mexico, Prince Rupert, Vancouver, B. C.—The Prince Rupert Dry Dock Company, Newman Erb, of New York, president, has a contract for the construction for Mexico of several steel revenue cutters, two cargo-carriers of about 1,000 tons each and a number of oil-tankers of from 7,500 to 10,000 tons each, the whole contract amounting to several millions of dollars.

Two-Class Passenger Liners, England.—Six of the new passenger liners to be constructed in the United Kingdom for the Cunard Line will be two-class passenger liners. The cabin rates on this type of ship will be much lower than those on the larger vessels. The first of these vessels, to be put on the American run on February 6, 1921, will be the Albania, making her maiden voyage.

Vessel Repair Contracts, Baltimore, Md.—The Shipping Board has awarded contracts for repairs to the Independence Bridge to the Marine Engineers' Corporation, the Capulin to the Curtis Bay Copper & Metal Works, the Western Comet to the Baltimore Dry Docks & Shipbuilding Company, and the Honadage to the Globe Shipbuilding Company, all of which yards are in Baltimore, Md., or vicinity.

Oil Tankers, Everett, Wash.—M. E. Barnham, receiver of the Norway Pacific Construction & Dry Dock Company, has a proposition from responsible oil interests which propose to build six steel tankers in the Everett yards of the company under the receivership, providing the creditors' consent has been secured and a court decree is made directing the receiver to enter into the contracts. The six tankers are to be of 12,000 deadweight tons with a capacity of 78,000 barrels each.

Reconditioning Liner, Quincy, Mass.—The Fore River Yard of the Bethlehem Shipbuilding Corporation has been awarded the contract for reconditioning the 17,000-ton liner Minnekahda, recently transferred from British to American registry, by the International Mercantile Marine Company. The work will cost

\$1,000,000 and require three months for completion. When ready the vessel will be capable of transporting 2,150 third-class passengers. The other ships of the company will also be converted.

Reconditioning Steamer.—The United States Mail Steamship Company, of New York, will convert the Amphion and Freedom into passenger carriers, for which plans have been completed and contracts awarded. Plans and specifications conform to the highest requirements of the American Bureau of Shipping. The Amphion will have accommodations for cabin as well as 1,300 third-class passengers, and a cargo capacity of about 4,000 tons. The Freedom will carry 1,000 third-class passengers and about 3,500 tons of cargo.

Barkentines, Victoria, B. C.—Four four-masted barkentines, each of 2,500 tons, three of which are well under way, are being built at the Chilberg Shipyards, Ltd., to engage in the lumber trade, and will be capable of carrying 1,500,000 feet of lumber. The keel for the fourth vessel was laid late in November when the first of the barkentines was launched. These vessels are built on special design for the Victoria Shipyards, Ltd., a concern of British Columbia capitalists who have the backing of the Canadian government.

Idle Ships To Be Tankers, San Francisco, Cal.—D. W. Dickie, marine architect, will present plans to the Shipping Board for the converting of freighters now lying idle, and hulls that were built under war contracts and never completed, into oil carriers as a means for relieving the present shortage of tankers in the United States. The plans call for the installation of tanks in the freighters and refitting the crafts with Diesel electric engines in place of turbines. Conversion of the freighters into oil tankers would be undertaken at the time of the engine changes.

Tankers for Mexican Trade, Wilmington, Del.—The installation of a single-ended Scotch boiler ten minutes after the launching of the 10,000-ton tanker Eugene V. R. Thayer, for the Sinclair Navigation Company, and the placing into position of the others immediately after, is believed to be a record by the Harlan plant of the Bethlehem Shipbuilding Corporation. Work on three other tankers building at the Harlan plant for the Sinclair Company, and two building at the Fore River plant, is being expedited in an effort to fill the immediate need of the company for vessels in its Mexican petroleum oil trade.

To Build Eight Steamers, Chester, Pa.—The last of the government vessels building at the yard of the Merchant Shipping Corporation was launched recently, and the ways will be filled with private contract vessels for the following owners: Union Oil Company (Del.), two single-screw tankers, 10,000 deadweight tons each, triple-expansion vertical inverted cylinder reciprocating engines; Tide Water Oil Company, two tankers of same type and tonnage as Union Oil Company; Shawmut Steamship Company, two single-screw combination passenger and cargo boats, 10,500 deadweight tons each, Westinghouse cross-compound turbines with double reduction gears American Hawaiian Steamship Company, two twin-screw freighters, 11,000 deadweight tons each, Diesel engine.

To Install Engines, Port Richmond, S. I. N. Y.—The Staten Island Shipbuilding Company has secured several large jobs. One contract is for the installation of eight compound engines, 16 x 32 x 24 inches, in four ships of the Mexican Petroleum Company's fleet which were propelled formerly by electricity. The engines will be built by the Staten Island Shipbuilding Company. The first engine to be installed by February, 1921, and an installation to be effected monthly thereafter. Two new boilers are to go on one of these ships. The company is converting two bulk freight carriers, Twilight and Sunlight, belonging to the Standard Oil Company of New Jersey, by installing two longitudinal bulkheads and five athwart bulkheads in each ship. A total of about 250 tons of steel is required for each vessel.

SHIPYARDS AND DRY DOCKS

New Machine Shop, Beaumont, Tex.—The Beaumont Shipbuilding & Dry Dock Company plans a machine shop at a cost of \$100,000.

New Yard Planned, New Bern, N. C.—The Newport Shipbuilding Company is planning the construction of a new shipyard at Wilmington, N. C.

Bond Issue of Shipbuilding Company, Los Angeles, Cal.—The Los Angeles Shipbuilding & Drydock Company has arranged for a bond issue of \$1,250,000.

New Marine Works, Beaumont, Tex.—The Beaumont Marine Engineering Works has been incorporated, with a capital of \$15,000, by J. C. Ellison, Roy Kellogg and John Currie.

Will Rebuild Shipyard, Tampa, Fla.—The Oscar Daniels Company plans to rebuild its shipyard and blacksmith shop recently burned. Loss estimated at from \$20,000 to \$25,000.

Shipbuilding Company To Be Dissolved, Vancouver, Wash.—The Great Northern Concrete Shipbuilding Company, which built five concrete ships during the war, has filed a petition for dissolution.

New Shipbuilding Company, Hoboken, N. J.—The Baltimore-New York Ship Service Corporation, 77 River street, was recently incorporated, with a capital stock of \$500,000, to build ships, engines, etc.

Shipyard to Reopen, Slidell, La.—The plant of the Merrill-Stevens Shipbuilding Company will be reopened soon, according to S. Cuyler Jenkins and W. J. Payne, principal owners of the Louisiana plant.

Shipbuilding Plant for Sale, South San Francisco, Cal.—The Schaw-Batcher Company's shipbuilding plant has been placed on sale either as a whole or piecemeal. The plant has been designed for emergency fleet work, and cost \$1,750,000.

Marine Railway, Etc., Wilmington, N. C.—A marine railway capable of accommodating vessels of 2,000 tons and 250 feet in length and costing \$60,000 will be constructed by the Stone Towing Company. Machine and woodworking shops modernized are also planned.

To Remodel Shipyard, New Equipment, Etc., Jacksonville, Fla.—The Merrill-Stevens Shipbuilding Corporation will remodel the former shipyard of the Terry & Brittain Company, recently acquired. Equipment will be provided for the construction and repair of all kinds of vessels. J. E. Merrill is vice-president and general manager.

New Shipbuilding Corporation, Jacksonville, Fla.—The Duval Corporation has been formed, with a capital of \$400,000, by Eli Ness, M. A. O'Bryne and P. H. Haslam, all of Savannah, Ga., for the purpose of operating the 65-acre shipyard recently purchased by Mr. Ness from the Merrill-Stevens Shipbuilding Company as a steel shipbuilding plant.

Shipyard Leased, Wilmington, N. C.—The Liberty Shipyard has been turned over to the Newport Shipbuilding Corporation, under a five-year lease, and construction will be rushed on three concrete tankers and four river steamers. The company has secured contracts for two years, making necessary the employment of 500 men at an estimated pay-roll of \$1,000,000 per year.

Marine Basin, Flushing Bay, N. Y.—The Robins-Ripley Company, of Manhattan, has purchased about twelve acres of land, half of which is under water, near the Red Star Company's property, on Flushing Bay, where a marine basin will be established by the construction of bulkheads and filling in. Plans are being developed and construction will begin early in the new year.

Canadian Yard to Resume Operation, Toronto, Canada.—The Dominion Shipbuilding Company's plant, which has been idle for several months, will be in operation soon, when the Henry Hope Company, of Peterboro, will complete the construction of two boats which the government had ordered some time ago. It is probable that more orders may be forthcoming and the plant kept running throughout the winter.

Shipbuilding Plant Sold, Mobile, Ala.—The shipbuilding plant formerly operated by the Fred T. Ley Company for the Shipping Board has been sold to H. A. Stone, of Philadelphia, Pa., for \$141,600. This includes real estate, buildings, equipment, machinery and ship material with the exception of unused lumber. The plant has nearly a half mile of water frontage and good railroad connections.

Yard Without Future Plans, Newark, N. J.—The present programme of the Submarine Boat Corporation is nearly completed, and Henry Carse, president of the company, stated that no plans for the shipyard have been made. Some time ago it was reported that the company was planning to build large fabricated steel freighters equipped with Diesel engines. Nothing definite has been announced, however.

Building New Yard, Flushing Bay, N. Y.—The Red Star Towing Company, of Manhattan will have its new shipyards at Thirteenth street ready for business in a couple of months. The company is building two shipways for construction and repair work. The bulkhead was made by filling a dozen or so old scows with ashes and sinking them along about 600 feet of waterfront, the space back of the head being also filled in.

New Floating Drydock, Toronto, Can.—A floating drydock 300 feet in length and costing between \$75,000 and \$80,000 is now being constructed at Ashbridge's Bay to accommodate the largest freighters on the Great Lakes. The dock was built in Montreal for the John E. Russell Shipbuilding Company, Toronto, and the sections are being towed from Montreal. This dock will save vessels being sent to Collingwood or Kingston for repairs.

New Shipbuilding and Repair Plant, Gloucester, N. J.—John Meigs, Philadelphia, Pa., former assistant director of the local department of wharves and docks, and associates have organized a company to establish a ship construction and repair plant in the vicinity of Gloucester, N. J., and have secured options on a site on the Delaware River near the Reading ferry. Plans are being prepared for shops, and large floating drydock. R. E. Havens, 507 Federal street, Camden, N. J., is engineer.

Dry Dock, Esquimaux, B. C.—The Dominion Public Works Department, Ottawa, Canada, will receive bids until December 9 for the construction of a drydock in Skinner Cove a short distance from the present government dock. The dock will have a length from outer caisson stop to head wall of 1,150 feet, width of entrance 125 feet on sill, and 135 feet at coping level; depth on sill at ordinary high water spring tides, 40 feet. The dock will have two inner sills located 400 and 750 feet from the entrance sill, respectively. Two floating caissons will be provided for closing outer and inner entrances.

Floating Shipyard, New York.—A new ship repair plant, which will operate in New York, is being completed by the Globe Ship Repair & Marine Supply Company. Captain C. A. Massey is president of the new concern, and James McKeller, vice-president and general manager. This plant will be especially designed to expedite repairs on steamers above the water line. The plant is on a boat and can go alongside of a vessel at short notice, and do all necessary repairing while the vessel is in the stream or at the dock. It will be able to make all kinds of engine and boiler repairs, electric and acetylene welding and cutting, pipe fitting and plumbing, repairs to hull, painting and scraping; in fact, everything required except drydocking.

PORT IMPROVEMENTS

Sea Wall, Port Lavaca, Tex.—The city has voted bonds for \$120,000 to cover cost of constructing a sea wall. Address D. E. Guidry, Mayor.

Water Front Improvements, Arkansas Pass, Tex.—The city will vote on \$225,000 bonds to improve the water front. R. Savage, Corpus Christi, Tex., attorney.

New Piers, New York.—A couple of good-sized piers are to be erected on the site of the old Williamsburgh ferry house at Roosevelt street and the East River.

Terminal and Freight Warehouse, New Bern, N. C.—A terminal and freight warehouse are to be built for the new Federal Boat Line connecting New Bern with Baltimore and northern points.

Seawall, Bay St. Louis, Miss.—Gulfport, Miss., city commissioners plan to construct a seawall at Bay St. Louis, along the city front; reinforced concrete construction. H. D. Shaw is engineer.

Quays, Rio de Janeiro, Brazil.—The Company of the Port has addressed a petition to the Government demanding the construction of new quays, made necessary by the steady increase in the traffic at the port.

Dock Equipment, Portsmouth, Va.—The City Council plans an appropriation of \$3,500,000 for freight handling machinery, conveying and loading machinery, cranes, etc., to be installed on the city's new municipal docks.

Wharf, Thetis Island, B. C.—The Department of Public Works, Ottawa, Canada, let contract for building a wharf at Thetis Island to the Vancouver Pile Driving & Contracting Company, 207 Hastings street, W., Vancouver, B. C.; about \$64,000.

Electric Dredge, Gray's Harbor, Wash.—Provisional plans are being drawn by C. A. Strong, port engineer, for the construction of a \$250,000 dredge for port development work. The dredge will be of 22-inch section type and operated by electricity.

Dredging, Seattle, Wash.—The Board of Public Works will soon receive bids for dredging east slip of Pier A. Smith's Cove, for filling Elliott avenue, involving 200,000 cubic yards dry earth excavation. A. H. Dimock, Seattle, is engineer.

Grain Elevator, Brooklyn, N. Y.—Building of a 1,250,000 bushel grain elevator by the state has been begun at the foot of Columbia street, and it is expected that a total capacity of 20,000,000 bushels will be provided to take care of shipments from lakes by way of the State Barge Canal.

New Wharf, New Orleans, La.—W. O. Hudson, president of the New Orleans Dock Board, has completed negotiations with the War Department for 1,200 feet of wharf space at the Army Supply Base for a new wharf. He also bought a submarine chaser to be used as a fireboat, from the Navy Department.

Dredging, New York.—Murray Hulbert, Commissioner of Docks, Pier A, North River, New York, has let contract for dredging piers at Stanton street, East Fifth, East Twentieth, East Second and West Thirty-fifth streets to the Morris & Cummings Dredging Company, 17 State street, New York; \$111,685.

Piers, Oswego, N. Y.—E. S. Walsh, superintendent of Public Works, Albany, N. Y., let contract for building concrete foundation piers for the proposed grain elevator on Barge Canal Terminal pier (Terminal Contract 80), to the Brown & Lowe Company, and Law Brothers, Foster avenue, Schenectady; about \$336,412.

Dredging, Etc., Fort Worth, Tex.—The city plans to dredge the Trinity River from Paddock Viaduct to a point near Lake Worth, and also dig a canal to connect with the lake. Plans also include two locks and dams to permit boats to run from Fort Worth to the lake; about \$250,000. W. D. Davis, mayor.

Barge Canal Terminal, Gowanus Bay, N. Y.—Ground for the new State Barge Canal terminal on Gowanus Bay, to cost about \$428,000, was broken about the middle of November, and the work will be rushed ahead as fast as possible. The concrete work of the southern half of the stock is to be completed by July 1, 1921.

New Dock, Savannah, Ga.—The Savannah Coal & Dock Company, recently organized, has taken over the river frontage formerly occupied by the Foundation Company as a shipyard for a ship coaling station. Contract for a new dock and other features of the enterprise has been let to the A. Bentley & Sons Company, Toledo, Ohio.

Pier, Toronto, Canada.—The Department of Public Works, Western Block, Ottawa, Canada, let contract for building 466 feet of superstructure of east pier at eastern channel of Toronto harbor, involving 2,000 cubic yards reinforced concrete, to S. Boone Dredging & Construction Company, Ltd., Excelsior Life Building; \$68,679.

Wharves, Docks, Piers, Etc., Baltimore, Md.—The city has voted on a \$2,500,000 loan for extensive harbor improvements, including the acquisition of sites on which the city intends to construct wharves, docks, piers, bridges, etc.; \$10,000,000 was also voted for the development and extension of the harbor. W. F. Broening, president Board of Awards.

Terminal Contract Awarded, Havana, Cuba.—The firm of Snare & Trieste, New York, has been awarded the contract for building the Ward Line's new terminal at Havana. This is largely a bulkhead proposition and will be equipped with the most modern and improved freight-handling machinery. The project will require about two years for completion.

Piles, Bulkhead, Etc., Brooklyn, N. Y.—Contract T-79, E. S. Walsh, Superintendent of Public Works, Capitol, Albany, N. Y., has let contract for driving foundation piles for proposed grain elevator, building concrete bulkhead wall on Henry street, and dredging Henry Street Basin, Gowanus Bay, to Raymond Concrete Pile Company, 90 West street, New York City, \$428,259.

New Jersey Canal.—Colonel J. C. Sanford, of the Army Engineers, will make a report to the Government on the proposed 33-mile canal tapping the Delaware River near Bordentown, south of Trenton, N. J., and connecting with Raritan Bay near South Amboy, which will give New York, Baltimore and Philadelphia, as well as other cities along the canal, through inland waterway connection.

Wharves, Warehouses, Etc., Argentine, S. A.—Extensive port improvements are being undertaken by the Government of Argentine. Work has begun on improving the port at Commodore Rivadavia the outlet for the oil fields. Wharves and warehouses are to be built at a cost of \$1,700,000. At Rosario the Government expects to spend \$3,000,000 for increasing the dockage and warehouse facilities.

Dredging, Philadelphia.—The Canal Construction Company, Philadelphia, Pa., has been awarded a contract for the restoration of the 12-foot channel between Philadelphia and Trenton. The work of removing rock and recently formed shoals and otherwise improving the channel will be under the direction of Colonel Ladue, United States engineer; \$55,000 has been appropriated for the work.

\$6,000,000 Ocean Terminal, Seattle, Wash.—Construction of a \$6,000,000 ocean terminal for the Pacific Steamship Company on the twenty-six-acre site of the former Skinner & Eddy yard has been taken under consideration by the Shipping Board, the completed terminal to be bought by the steamship company. Plans call for three 1,000-foot piers with berthage for twelve ocean ships at a time, and a five-story steel and concrete warehouse and office building; the pier, transit sheds and warehouse to have a cargo capacity of more than 325,000 tons, and to be equipped to handle millions of tons of freight each year.

\$100,000,000 Port Project, New York.—Alton H. Greeley, of Cleveland, Ohio, president of the American Chain of Warehouses, has again presented to a special sub-committee of the Board of Estimate of New York City a plan for the expenditure of \$100,000,000 private capital on the development of 1,000 acres of city-owned land north of Barren Island and east of Flatbush avenue. The programme includes the construction of a 5,000-foot bulkhead, six 1,000-foot piers, warehouses, streets and industrial plants at an expense of \$14,000,000. The project is contingent upon the United States Government dredging the channel to a depth of 30 feet.

New Docks, Dredging, Etc., Melbourne, Australia.—The Port of Melbourne Authority, the Harbor Trust Commissioners, have prepared a scheme for the construction of a series of new river docks on the north of the Yarra, westerly from the Victoria Dock, which provides for four docks covering 800 acres, costing approximately \$24,355,072. The first dock to be built will provide 20 additional berths, and will have a total area of 86.61 acres, giving a berthage space of 11,400 feet. The cost of this dock is estimated at \$5,307,684. Of the four docks provided for, three are to be served by one entrance 250 feet wide, at the junction of the Yarra and Maribyrnong rivers. The remaining dock will be served by a separate entrance 200 feet wide. The general depth of the water is to be 32 feet. The Maribyrnong River is to be widened to 300 feet and deepened to 27 feet for some distance beyond the junction with the Yarra.

SHIPPING DEVELOPMENTS

Transportation Company, Baltimore, Md.—The Covington Maritime Corporation, 111 N. Charles street, was organized by Wynn L. Van Schaick, John B. Johnson and George R. Gaither.

New Steamship Line, New London, Conn.—Plans have been completed for a new coastwise service between New London, Conn., and Norfolk, Va., by the Manufacturers' Association of Connecticut.

Steamship Company Organized, Baltimore, Md.—The Bella Steamship Company, 803 Calvert Building, has been incorporated, with a capital of \$250,000, by Antonio T. Carrozza, John H. Leonard and Edwin H. Brownley.

New Steamer Sold, New York.—The new 9,400 deadweight ton steel merchant vessel Charles M. Cramp has been sold to the Atlantic, Gulf & Pacific Steamship Company, 13 Park Row, for \$1,739,900 by the Shipping Board.

New Shipping Firm, Boston, Mass.—The Keans Transportation Company, Inc., 114 State street, has been incorporated by Guy L. Keans to manage sailing vessels. The company now has four schooners in service and has plans for expansion.

New Steamship Company, New York.—The Polish Navigation Company, Inc., was recently incorporated, with a capital of \$3,000,000, and is planning the purchase of a ship for establishing service between New York and Danzig. K. S. Pomierski, 1777 Broadway, is vice-president and secretary of the company.

Pensacola-Cuba Service, Pensacola, Fla.—A new steamship line between Pensacola and Matanzas, Cuba, will be established by the Gulf, Florida & Alabama Railroad, according to H. W. Stigler, agent for the line in Memphis. The first vessel will sail from Pensacola soon, and freight will be accepted for all points in Cuba, including Havana.

First "535" Ship Nearly Ready, New York.—The steamer Wenatchee, first of the new "535" vessels to be commissioned by the Shipping Board, will be turned over to the Pacific Steamship Company, December 31, at New York, and is to be placed in the transpacific service. Several similar steamers are to be allocated to the Pacific Mail Steamship Company.

Buys Old Dominion Steamers, Norfolk, Va.—The Old Dominion Transportation Company recently organized to take care of the truck shipments to the north, has bought the steamers Hamilton and Jefferson from the Old Dominion Steamship Company for \$850,000, and has taken over the Norfolk terminals of the steamship company.

Winter Sailings from Portland, Me.—The first sailing from Portland on the Anchor-Donaldson Line service between Portland and Glasgow during the winter will be the steamer Saturnia, sailing on December 9, it being a Christmas sailing. Other sailings will be the steamer Cassandra, on December 30, February 18 and March 30, and the Saturnia, on January 18, March 11 and April 30.

American Vessels and Oriental Trade.—It is reported by the Manila agency of the Osaka Shosen Kaisha that vessels of the United States Shipping Board have finally been admitted into what is known in the Orient as the China Home-ward Conference, a concession which, if confirmed, will grant vessels flying the American flag the privileges enjoyed by other vessels plying in the China trade.

Lake Ship Line Control Sold, Benton Harbor, Mich.—It is announced by J. H. Morton, president and general manager of the Graham & Morton Transportation Company, operating steamers on Lake Michigan between Chicago, Benton Harbor and Holland, Mich., that the controlling interest of the company has been sold to Nathaniel Robbins, of Grand Haven, Mich. Mr. Morton will continue as general manager.

Intercoastal Trade Plans.—Nine companies have entered or announced their intention of entering the intercoastal trade between the Atlantic and Pacific. They include the Pacific Mail, Luckenbach Lines, United American Lines (Williams, Diamond & Co.), Isthmian Lines, Robert Dollar Company, Admiral Line, Sudden & Christensen, Atlantic, Gulf & Pacific Steamship Corporation and Matson Navigation Company.

Ex-German Steamer Bought, New York.—The International Mercantile Marine Company has bought the 17,324-ton German steamship Berlin from the British Government, and is in the market for others of the German ships now for sale in England, with which to build up the White Star fleet to its pre-war strength. The Berlin is 590 feet long, 69 feet wide and 38 feet depth of hold, has reciprocating engines and a speed of 18 knots.

Coast to Coast Service, Newark, N. J.—The Transmarine Corporation coast to coast service via the Panama Canal will be opened with the sailing of the steamer Suricheo from Port Newark, N. J., to San Pedro, San Francisco and Portland. The vessel will also accept traffic for Hoquiam and Aberdeen, Wash. The Transmarine Corporation is a subsidiary of the Submarine Boat Corporation, 5 Nassau street, New York.

New Steamship Corporation, New York.—The Roosevelt Steamship Corporation has been incorporated under the laws of Delaware, with a capital of \$1,000,000, by Kermit Roosevelt, former vice-president of the Kerr Steamship Company, Russell Goldman and Max Zaliels, all of New York. The company has purchased the harbor tug Kermit from the American Ship & Commerce Corporation and intends to go in for allocations of Shipping Board vessels in world-wide trade.

Steamers for West Indies, New York.—The International Maritime Lines, of No. 44 Whitehall street, are planning to place all their Lake type steamers in West Indies business and to put four 7,300 tonners of the Hog Island type or 8,800 tonners in Scandinavian business. In connection with this development a new corporation to be capitalized at several millions is to be created. The corporation has been sending vessels to Scandinavia for nearly two years. E. V. Culberson is treasurer.

Electric Passenger Ship, Brooklyn, N. Y.—The Cuba, a 300-foot steamer and the first passenger vessel to be fitted out with an electric drive, passed her dock trials at the yard of the

Morse Dry Dock and Repair Company, and has been placed in commission in the Jacksonville-Havana run. The Cuba was formerly the Powhatan. She was reclaimed after being sunk in Chesapeake Bay and virtually rebuilt. The Cuba is electrically driven, electrically lighted and her winches are electrically operated.

New Steamship Company, Philadelphia, Pa.—The Pennsylvania Trans-Atlantic Steamship Company is being organized, with a capital of \$1,000,000, to transact a general shipping business and to own and operate vessels from Philadelphia to all parts of the world. The new company proposed to purchase from the Government, on the deferred payment plan, ten ships with a capacity of 60,000 tons. It is claimed that the company has contracts in hand for the movement of coal from the Atlantic range to French Atlantic ports.

To Operate Refrigerator Steamers, New York.—The five Shipping Board refrigerator steamers which were surrendered by operators whose time charters had expired will be continued by the International Freight Corporation, 170 Broadway, and will run from Philadelphia to the River Plate and thence to Liverpool, Antwerp and Rotterdam, returning to Philadelphia. The fleet includes the steamships Monasses, Oskawa, Yauhill and Guimba. Two of these are now being operated by the Elder Steel Steamship Company, whose charters will expire on January 1, and they will at once be transferred to the International Freight Corporation.

Round the World Service, Portland, Ore.—A new round-the-world service from Portland, with San Francisco as a port of call, is to be established by Gerritsen, Curtis & Co., under the name of the Curtis Line, according to Clifton Curtis Jr., vice-president and general manager. The line will operate chartered steamers. It will proceed eastward or counterwise to the Pacific Mail 'round-the-world' service. Leaving Pacific Coast ports, the vessels will go to the United Kingdom, Antwerp, Rotterdam, Stockholm and other northern European ports, thence to Marseilles, Mediterranean ports, the Suez Canal, Dutch East India, Manila, Saigon, Hong Kong and other Far East ports, and return to the United States Pacific harbors.

GOVERNMENT WORK

Steam Locomotive Jib Crane, South Boston, Mass.—Specification 4263, Bureau of Yards and Docks, Navy Department, Washington, D. C., will receive bids on a 50-ton steam locomotive jib crane.

Lighthouse, Bowler's Rock, Va.—The Superintendent of Lighthouses let contract for building a lighthouse to the Raymond Construction Pile Company, Munsey Building, Baltimore, Md., \$18,000.

Dredging, Stamford, Conn.—The United States Engineer let contract for dredging in Stamford and Norwalk harbors to J. S. Packard Dredging Company, 1004 Turks Head Building, Providence, R. I.; \$107,000.

Building and Improvements, Quantico, Va.—Specification 4334, Bureau of Yards and Docks, Navy Department, Washington, D. C., plans extensive improvements and construction of buildings (large contract).

Dredging, Galveston, Tex.—United States Engineer, War Department, Washington, D. C., let contract for dredging part of the waterway from Galveston to Corpus Christi, Tex., to J. Jacobson, Galveston, Tex., \$4,000.

Machine Shop, Etc.—Bureau of Yards and Docks, Navy Department, Washington, D. C., has completed plans for a new one-story machine shop and testing works for the Navy Department, 82 x 300 feet; one-story foundry, 60 x 100 feet, and power plant, 70 x 81 feet.

Piers and Dredging, Newport, R. I.—Specification 4090, Bureau of Yards and Docks, Navy Department, Washington, D. C., let contract for building a new pier, extending two piers and dredging at Goat Island, to Booth & Chase Company, Inc., 29 Bedford street, Fall River, Mass., \$71,967, 210 days.

MARINE SOCIETIES

AMERICA

AMERICAN SOCIETY OF NAVAL ENGINEERS

Navy Department, Washington, D. C.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

29 West 39th Street, New York.

NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS

29 West 39th Street, New York City.

UNITED STATES NAVAL INSTITUTE

Naval Academy, Annapolis, Md.

NATIONAL ASSOCIATION OF MASTERS, MATES AND PILOTS

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National Treasurer—A. B. Devlin, 187 Randolph Ave., Jersey City, N. J.
National Secretary—M. D. Tenniswood, 308 Vine St., Camden, N. J.

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Vice-President—E. H. Monroe, 902 Virginia Ave., Washington, D. C.
Secretary—B. G. Barnes, 970 High St., Bath, Maine.
Treasurer—J. B. Sadler, P. O. Box 987, Norfolk, Va.
Executive Committeemen—G. W. Nusbaum, Washington, D. C.; A. H. Haag, Narberth, Pa.; John Thomson, Bethlehem, Pa.

NATIONAL MARINE ENGINEERS' BENEFICIAL ASSOCIATION OFFICERS

National President—Wm. S. Brown, 356 Ellicott Square Bldg., Buffalo, N. Y.
National Secretary-Treasurer—Geo. A. Grubb, 356 Ellicott Square Bldg., Buffalo, N. Y.

CANADA

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Grand President—E. Read, Rooms 10-12, Jones Building, Vancouver, B. C.
Grand Vice-President—Jeffrey Roe, Levis, P. Q.
Grand Secretary-Treasurer—Neil J. Morrison, Box 886, St. John, N. B.
Grand Conductor—E. A. House, Box 333, Midland, Ont.
Grand Door Keeper—Lemuel Winchester, 306 Fitzroy Street, Charlottetown, P. E. I.
Grand Auditor—W. C. Woods, Toronto, Canada.
Grand Auditor—J. C. Adams, 1704 Kitchner Street, Vancouver, B. C.

GREAT BRITAIN

INSTITUTION OF NAVAL ARCHITECTS

5 Adelphi Terrace, London, W. C.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

39 Elmbank Crescent, Glasgow.

NORTHEAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

Bolbec Hall, Westgate Road, Newcastle-on-Tyne.

INSTITUTE OF MARINE ENGINEERS, INCORPORATED

The Minorics, Tower Hill, London.

ITALY

COLLEGIO DEGLI INGEGNERI NAVALI E MECCANICI IN ITALIA,
Via Carlo Alberto 18, Genova.